



# STIC Search Report

EIC 1700

STIC Database Tracking Number: 193757

**TO:** Raymond Alejandro

**Location:**

Art Unit : 1745

June 23, 2006

16501

**Case Serial Number:** 10627705

**From:** Kathleen Fuller

**Location:** EIC 1700

REMSEN 4B28

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## Search Notes

I DID A STRUCTURE SEARCH FOR THE SI COMPOUND AS WELL AS A TEXT SEARCH.

**SEARCH REQUEST FORM****Scientific and Technical Information Center**

Requester's Full Name: Raymond Alejandro Examiner #: 76895 Date: 06/22/06  
 Art Unit: 1745 Phone Number 30 2-1282 Serial Number: 101627705  
 Mail Box and Bldg/Room Location: Benn 6D-01 Results Format Preferred (circle): PAPER DISK E-MAIL

If more than one search is submitted, please prioritize searches in order of need.

Please provide a detailed statement of the search topic, and describe as specifically as possible the subject matter to be searched. Include the elected species or structures, keywords, synonyms, acronyms, and registry numbers, and combine with the concept or utility of the invention. Define any terms that may have a special meaning. Give examples or relevant citations, authors, etc, if known. Please attach a copy of the cover sheet, pertinent claims, and abstract.

Title of Invention: Composite Electrolyte Membrane & Fuel Cell Containing the same  
 Inventors (please provide full names): Che et al

Earliest Priority Filing Date: 07/28/03

\*For Sequence Searches Only\* Please include all pertinent information (parent, child, divisional, or issued patent numbers) along with the appropriate serial number.

Please, search for the subject matter of  
 Claims 1-20. See attached copy thereof.

| <b>STAFF USE ONLY</b>        |                  | <b>Type of Search</b> | <b>Vendors and cost where applicable</b> |
|------------------------------|------------------|-----------------------|--|
| Searcher:                    | <u>R. Fuller</u> | NA Sequence (#)       | STN <input checked="" type="checkbox"/>  |
| Searcher Phone #:            |                  | AA Sequence (#)       | Dialog                                   |
| Searcher Location:           |                  | Structure (#)         | Questel/Orbit                            |
| Date Searcher Picked Up:     |                  | Bibliographic         | Dr. Link                                 |
| Date Completed:              | <u>6/23/06</u>   | Litigation            | Lexis/Nexis                              |
| Searcher Prep & Review Time: | <u>40</u>        | Fulltext              | Sequence Systems                         |
| Clerical Prep Time:          |                  | Patent Family         | WWW/Internet                             |
| Online Time:                 | <u>84</u>        | Other                 | Other (specify)                          |

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MOST RECENT DERWENT UPDATE: 200639 <200639/DW>  
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=> D QUE L44  
L31 8084 SEA FILE=WPIX ABB=ON NAFION OR CATION? (2A) EXCHANG? (4A) (POLYMER  
? OR RESIN?)  
L32 2110 SEA FILE=WPIX ABB=ON (?SILANE? OR ?SILOXAN?) (5A) (?SULFONAT?  
OR ?SULFID? OR ?MERCAPT?)  
L33 12 SEA FILE=WPIX ABB=ON L31 AND L32  
L34 2423 SEA FILE=WPIX ABB=ON (?SILANE? OR ?SILOXAN? OR SILICA) (5A) (?SU  
LFONAT? OR ?SULFID? OR ?MERCAPT? OR SO3X)  
L35 14 SEA FILE=WPIX ABB=ON L31 AND L34  
L36 14 SEA FILE=WPIX ABB=ON L33 OR L35  
L37 2917 SEA FILE=WPIX ABB=ON (?SILANE? OR ?SILOXAN? OR SILICA) (5A) (?SU  
LFON? OR ?SULFID? OR ?MERCAPT? OR SO3X)  
L38 1683 SEA FILE=WPIX ABB=ON SILICA(3A) MODIF?  
L39 29 SEA FILE=WPIX ABB=ON (L37 OR L38) AND L31  
L40 29 SEA FILE=WPIX ABB=ON L36 OR L39  
L42 4 SEA FILE=WPIX ABB=ON L40 AND H01M?/IC  
L43 4 SEA FILE=WPIX ABB=ON L40 AND (COMPOSIT? (3A) ELECTROLYT? OR  
FUEL (2A) CELL#)  
L44 4 SEA FILE=WPIX ABB=ON L42 OR L43

=> D L44 FULL

L44 ANSWER 1 OF 4 WPIX COPYRIGHT 2006 THE THOMSON CORP on STN  
AN 2005-240600 [25] WPIX  
CR 2005-416391 [42]  
DNN N2005-198295 DNC C2005-076558  
TI Catalysts composition for electrochemical catalyst used in fuel  
cells e.g. polymer electrolyte membrane fuel  
cells, for making stacks for electrical device and battery  
replacement, has carbon fibers bearing nanoparticles e.g. nanotubes.  
DC A85 L02 L03 P42 X16  
IN DONG, Y; LI, Y; WANG, N  
PA (INTE-N) INTEMATIX CORP  
CYC 109  
PI US 2005053826 A1 20050310 (200525)\* 32 H01M004-96 <--  
WO 2005084399 A2 20050915 (200561) EN H01M000-00 <--

RW: AT BE BG BW CH CY CZ DE DK EA EE ES FI FR GB GH GM GR HU IE IS IT KE LS LT LU MC MW MZ NA NL OA PL PT RO SD SE SI SK SL SZ TR TZ UG ZM ZW

W: AE AG AL AM AT AU AZ BA BB BG BR BW BY BZ CA CH CN CO CR CU CZ DE DK DM DZ EC EE EG ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NA NI NO NZ OM PG PH PL PT RO RU SC SD SE SG SK SL SM SY TJ TM TN TR TT TZ UA UG US UZ VC VN YU ZA ZM ZW

ADT US 2005053826 A1 Provisional US 2003-501158P 20030908, Provisional US 2004-549712P 20040302, US 2004-823088 20040412; WO 2005084399 A2 WO 2005-US7343 20050302

PRAI US 2004-823088 20040412; US 2003-501158P 20030908;  
US 2004-549712P 20040302; US 2004-898669 20040723

IC ICM H01M000-00; H01M004-96  
ICS B01J021-18; B01J023-42; B05D005-12; H01M004-88;  
H01M004-92; H01M008-10

AB US2005053826 A UPAB: 20050923

NOVELTY - A catalysts composition comprises carbon fibers bearing nanoparticles.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are also included for:  
(A) a fuel cell catalyst comprising nanoparticles

coated with continuous thin film comprising platinum (Pt) or a Pt alloy;

(B) an electrode-membrane combination comprising a first conductive electrode comprising a first fuel cell catalyst; a second conductive electrode comprising a second fuel cell catalyst; and a proton exchange membrane separating the first conductive electrode and the second conductive electrode;

(C) a fuel cell stack comprising electrically connected electrode membrane combinations;

(D) an electrical device, particularly transportation device, comprising the fuel cell stack;

(E) a battery replacement comprises a container containing a fuel cell stack and providing a positive electrode terminal and a negative electrode terminal for contacting to a device requiring electricity;

(F) a method of fabricating a fuel catalyst, comprising providing nanoparticles; and depositing on the nanoparticles a continuous thin film comprising Pt or Pt alloy;

(G) a method of preparing a fuel cell element, comprising providing fibers and/or a porous electrode material; depositing a nanoparticle catalyst on the fibers and/or porous electrode material; forming nanoparticles on the fibers and/or porous electrode material using the nanoparticles catalyst; and forming a catalytically active layer comprising continuous thin film on the nanoparticles thus forming a fuel cell element comprising fibers bearing nanoparticles partially or fully coated with a catalytically active thin film;

(H) a method of making a carbon nanotube for use in a fuel cell, comprising providing a nanotube growth catalyst; and forming a carbon nanotube on the catalyst; and

(I) a carbon nanotube, comprising a nanotube growth catalyst.

USE - The catalysts composition for electrochemical catalyst used in fuel cells e.g. polymer electrolyte membrane fuel cells. The fuel cells are used for making stacks for electrical device, particularly transportation device, and for battery replacement. The battery replacement powers a home, a cell phone, a lighting system, a computer and/or an appliance (all claimed).

ADVANTAGE - The catalyst composition reduces the platinum content and improves the catalytic efficiency.

DESCRIPTION OF DRAWING(S) - The figure shows a detailed structure of catalyst thin film/carbon nanotubes layer/carbon fiber sheet.

Dwg.1/14

TECH US 2005053826 A1UPTX: 20050419

TECHNOLOGY FOCUS - INORGANIC CHEMISTRY - Preferred Component: The nanoparticles are nanotubes, nanofibers, nanohorns, nanopowders, nanospheres, or quantum dots. The nanoparticles are carbon nanotubes. The carbon fibers comprise a porous electrode and carbon paper. The carbon nanotubes are seeded with one or more catalysts from  $Co_{1-x}Mo_x$  (1);  $Co_{1-x-y}Ni_xMoy$  (2);  $Co_{1-x-y}zNi_xVyCr_z$  (3);  $Ni_{1-x-y}Mo_xAl_y$  (4); or  $Co_{1-x-y}Ni_xAl_y$  (5). The carbon nanotubes are seeded with  $Co_8.8M-1.2$ ,  $Co_2.2Ni_5.6Mo_2.2$ ,  $Co_5.7Ni_2.1V_1.1Cr_1.1$ ,  $Ni_8Mo_1Al_1$ , or  $Co_6.4Ni_2.4Al_1.2$ . The nanoparticles are attached, or incorporated into, a porous carbon substrate, porous electrically conducting substrate, or polymer substrate. The nanoparticles are electrically coupled to an electrode. The first fuel cell catalyst and the second fuel cell catalyst are the same materials. The proton exchange membrane comprises Nafion, silicon oxide Nafion composite, polyphosphazenes (PPO), sulfonated PPO, or silica-polymer composites. The first conductive layer and first fuel cell catalyst further include a microdiffusion layer between the electrode and the catalyst. The first conductive electrode and the first fuel cell catalyst form an integral single layer. The first fuel cell catalyst and the second fuel cell catalyst each additionally acts as a microdiffusion layer. The second conductive electrode and the second fuel cell catalyst also form an integral single layer.

$x$  (for (1))=0-0.3;  
 $x$  (f(2))=0.1-0.7;  
 $y$  (for (2))=0-0.3;  
 $x$  (for (3) and (5))=0-0.7;  
 $y, z$  (for (3) and (5))=0-0.2;  
 $x, y$  (for (4))=0-0.2.

Preferred Parameter: The nanoparticles are nanotubes having a length of less than 50 microns, a width less than 100 nm, and a diameter of 50-100 nm. The proton exchange membrane has a thickness of 2-100 microns.

Preferred Method: The depositing is sputtering deposition, chemical vapor deposition (CVD), molecular beam epitaxy (MBE), plasma-assisted vapor deposition, or electron beam evaporation deposition.

TECHNOLOGY FOCUS - METALLURGY - Preferred Component: The thin film partially covers the nanoparticles. The nanoparticles are fully coated with the thin film. The thin film comprises an alloy comprising Pt, vanadium (V), and one or more of cobalt, nickel (Ni), molybdenum, tantalum, tungsten, and zirconium. The thin film comprises an alloy of formula  $PtxVyCozNiw$ .

$x=0.06-1$  (preferably 0.012);  
 $y=0.07$ ;  
 $z=0.56$ ;  
 $w=0.25$ ;  
 $x+y+z+w=1$ .

Preferred Parameter: The thin film has a thickness of 1-1,000 (preferably 5-100) Angstrom.

Preferred Composition: Platinum comprises up to 50% (preferably up to 12%) (mol. ratio or at.%) of the alloy.

TECHNOLOGY FOCUS - ORGANIC CHEMISTRY - Preferred Component: The nanoparticles are nanotubes, nanofibers, nanohorns, nanopowders, nanospheres, or quantum dots. The nanoparticles are carbon nanotubes. The carbon fibers comprise a porous electrode and carbon paper. The carbon

nanotubes are seeded with one or more catalysts from Co<sub>1-x</sub>Mo<sub>x</sub> (1); Co<sub>1-x-y</sub>Ni<sub>x</sub>Mo<sub>y</sub> (2); Co<sub>1-x-y-z</sub>Ni<sub>x</sub>VyCr<sub>z</sub> (3); Ni<sub>1-x-y</sub>Mo<sub>x</sub>Al<sub>y</sub> (4); or Co<sub>1-x-y</sub>Ni<sub>x</sub>Al<sub>y</sub> (5). The carbon nanotubes are seeded with Co<sub>8.8M-1.2</sub>, Co<sub>2.2Ni5.6Mo2.2</sub>, Co<sub>5.7Ni2.1V1.1Cr1.1</sub>, Ni<sub>8Mo1Al1</sub>, or Co<sub>6.4Ni2.4Al1.2</sub>. The nanoparticles are attached, or incorporated into, a porous carbon substrate, porous electrically conducting substrate, or polymer substrate. The nanoparticles are electrically coupled to an electrode. The first fuel cell catalyst and the second fuel

cell catalyst are the same materials. The proton exchange membrane comprises Nafion, silicon oxide Nafion composite, polyphosphazenes (PPO), sulfonated PPO, or silica-polymer composites. The first conductive layer and first fuel cell catalyst further include a microdiffusion layer between the electrode and the catalyst. The first conductive electrode and the first fuel cell catalyst form an integral single layer. The first fuel cell catalyst and the second fuel cell catalyst each additionally acts as a microdiffusion layer. The second conductive electrode and the second fuel cell catalyst also form an integral single layer.

x (for (1))=0-0.3;  
x (f(2))=0.1-0.7;  
y (for (2))=0-0.3;  
x (for (3) and (5))=0-0.7;  
y,z (for (3) and (5))=0-0.2;  
x,y (for (4))=0-0.2.

Preferred Parameter: The nanoparticles are nanotubes having a length of less than 50 microns, a width less than 100 nm, and a diameter of 50-100 nm. The proton exchange membrane has a thickness of 2-100 microns.

Preferred Method: The depositing is sputtering deposition, chemical vapor deposition (CVD), molecular beam epitaxy (MBE), plasma-assisted vapor deposition, or electron beam evaporation deposition.

ABEX US 2005053826 A1UPTX: 20050419

EXAMPLE - The carbon nanotubes deposited on the carbon fiber papers were used for enhancing the catalyst surface area and providing a micro gas-diffusion structure. The growth procedures for carbon nanotubes on carbon fiber of carbon paper were depositing 200Angstrom thick Ni on carbon fiber paper as catalysts; putting carbon fiber paper into tube-furnace; flowing argon (Ar) in 100 ml/minute rate to push air away for 30 minutes; flowing a mixture of Ar (50 ml/minute) and hydrogen (H<sub>2</sub>, 10 ml/minute) into tube furnace and starting rising temperature to 700degreesC in 20degreesC/minute; at 700degreesC, changing a mixture of gas flow to Ar (15 ml/minute), H<sub>2</sub> (15 ml/minute) and ethylene (50 ml/minute) into tube for 10 minutes; and cooling down temperature to 20degreesC at 20degreesC/minute. Nanotubes were ground in a miller with ethanol. The produced suspension was smeared or sprayed on the carbon paper. Pt was ion-beam deposited on the top surface of the smeared nanotubes. The measured catalytic effectiveness reached the level of that on grown nanotubes. Fuel cells were prepared by dropping nafion solution (5 mol%) on the catalyst coated carbon paper or carbon nanotubes/ carbon paper and drying it in air; cutting a piece of carbon electrode covered with Pt/ruthenium, carbon ink as catalyst; putting the standard electrode, membrane and the catalyst sample as a sandwich structure on the hot pressing machine; and pressing them in 1 ton pressure at 80degreesC for 10 minutes to form a fuel cell membrane assembly.

FS CPI EPI GMPI

FA AB; GI

MC CPI: A12-E06B; L02-F05C; L03-E04B

EPI: X16-C01C; X16-E06A1

=> D L44 FULL 2-4

L44 ANSWER 2 OF 4 WPIX COPYRIGHT 2006 THE THOMSON CORP on STN  
 AN 2004-629273 [61] WPIX

DNN N2004-497645 DNC C2004-226513

TI Composite electrolyte film, for fuel  
 cells, consists of modified silica having  
 sulfonic acid substituent and disulfide substituent  
 bonded with silicon atom, and polymer having cation  
 exchange group.

DC A85 L03 X12 X16

IN CHO, J H; PARK, C H; CHO, J; PAK, C

PA (SMSU) SAMSUNG SDI CO LTD; (SMSU) SAMSUNG DENKAN KK

CYC 4

PI JP 2004241391 A 20040826 (200461)\* 12 H01M008-02 <--  
 CN 1519970 A 20040811 (200476) H01M008-02 <--  
 KR 2004072082 A 20040818 (200481) H01M008-02 <--  
 US 2005175880 A1 20050811 (200553) H01M008-10 <--

ADT JP 2004241391 A JP 2004-30823 20040206; CN 1519970 A CN 2003-147567  
 20030724; KR 2004072082 A KR 2003-8007 20030208; US 2005175880 A1 US  
 2003-627705 20030728

PRAI KR 2003-8007 20030208

IC ICM H01M008-02; H01M008-10  
 ICS C08J005-22; H01B001-06; H01M010-40

AB JP2004241391 A UPAB: 20040923

NOVELTY - A composite electrolyte film consists of  
 modified silica having specific sulfonic acid  
 substituent and specific disulfide substituent bonded with silicon atom,  
 and a polymer having a cation exchange  
 group.

DETAILED DESCRIPTION - A composite electrolyte  
 film consists of modified silica having  
 sulfonic acid substituent of formula (I) and disulfide substituent  
 of formula (II) bonded with silicon atom, and a polymer having a  
 cation exchange group.

-R1-SO3X (I)

-R2-S-S-R3- (II)

R1 = 2-7C alkylene group;

X = H or alkali metal; and

R2 and R3 = 2-7C alkylene group.

An INDEPENDENT CLAIM is included for fuel cell  
 which consists of the electrolyte film provided between a cathode with  
 which reductive reaction of oxidizing agent occurs and anode with which  
 oxidation reaction of fuel occurs. The electrolyte film is the  
 composite electrolyte film.

USE - Fuel cell (claimed) used for industrial  
 purposes, domestic and electric power for vehicle drive, and electric  
 power supply of small-sized electrical/electronic components, especially  
 portable apparatus.

ADVANTAGE - The composite electrolyte film  
 suppresses the permeation of polar organic fuels such as methanol. The  
 film has improved ionic conductivity. Crossover of methanol is suppressed  
 when the nano composite electrolyte film is used to  
 direct methanol fuel cell. Operation efficiency and  
 lifetime of fuel cell utilizing the film are improved.

DESCRIPTION OF DRAWING(S) - The graph shows the methanol permeability  
 of composite electrolyte film. (Drawing includes  
 non-English language text).

Dwg.1/1

TECH JP 2004241391 AUPTX: 20040923

*Application*

**TECHNOLOGY FOCUS - INORGANIC CHEMISTRY - Preferred Composition:**  
 The composite electrolyte film contains 2-20 mass% of modified silica.

**Preferred Property:** The modified silica has particle size of 2-10 nm.

**TECHNOLOGY FOCUS - ORGANIC CHEMISTRY - Preferred Group:** The cation exchange group of the polymer is chosen from sulfonic acid group, carboxyl group, phosphoric acid group, imide group, sulfonimide group and sulfonamide group.

**TECHNOLOGY FOCUS - POLYMERS - Preferred Group:** The polymer has sulfonic acid group as cation exchange group at the terminal of side chain. The polymer further contains a fluorinated polymer having number of fluorine atom of 90% or more in the number of fluorine atoms bonded with carbon atom of principal chain and side chain and number of hydrogen atoms. The polymer has a sulfonate as cation exchange group at the terminal of side chain.

ABEX JP 2004241391 AUPTX: 20040923

**EXAMPLE** - Sodium salt of dioctyl sulfo succinate (in g) (9.522) and n-hexanol (1.553) were supplied to a reactor and stirred. The sodium salt of dioctyl sulfo succinate was dissolved in n-hexanol. Subsequently, cyclohexane (100) was further supplied to the reactor. A Nafion film Nafion 115 fixed to a membrane kit was introduced into the solution in the reactor. 2 ml of aqueous ammonia was further supplied into the reactor and a white deposit was produced. Subsequently, 3-propyl trimethoxy mercapto silane (2.358) was gradually supplied to the reactor and the reaction was advanced for 96 hours. Sequential implementation of processing of ethanol washing, 1 hour vacuum drying at 100 degrees C, washing with acetone and 100 degrees C 1 hour vacuum drying was performed with respect to the processed Nafion film. The washed and dried Nafion film was dipped in 1M sulfuric acid aqueous solution, then heated at 100 degrees C for 1 hour. The Nafion film was then washed by distilled water and a composite electrolyte film was obtained by vacuum drying at 100 degrees C for 1 hour. The Nafion film was comprised of a high fluorinated polymer. The composite electrolyte film had improved ionic conductivity.

FS CPI EPI

FA AB; GI

MC CPI: A12-E06; L03-E04A2

EPI: X12-D01C; X16-C01C

L44 ANSWER 3 OF 4 WPIX COPYRIGHT 2006 THE THOMSON CORP on STN

AN 2004-483701 [46] WPIX

DNN N2004-381465 DNC C2004-180298

TI Membrane-electrode joint-component for fuel cell, has cation-exchange resin films arranged at anode and cathode electrode side, each film having preset acidic-radical concentration value.

DC A26 A85 L03 X16

PA (SEKISUI) SEKISUI CHEM IND CO LTD

CYC 1

PI JP 2004165047 A 20040610 (200446)\* 13 H01M008-02 <--

ADT JP 2004165047 A JP 2002-331000 20021114

PRAI JP 2002-331000 20021114

IC ICM H01M008-02

ICS H01M008-10

AB JP2004165047 A UPAB: 20040720

**NOVELTY** - A membrane-electrode joint-component has anode electrode (1) and cathode electrode (4) provided on both surface of cation-exchange resin films (2,3). (2, 3) are arranged at (1)

and (4) side, respectively. The acidic-radical concentration value (a) of (2) is lesser than acidic-radical concentration value (b) of (3). The value is molecular weight of cation exchange resin per acid radical.

DETAILED DESCRIPTION - An INDEPENDENT CLAIM is included for fuel cell having membrane-electrode joint component.

USE - For fuel cell (claimed).

ADVANTAGE - The membrane-electrode joint-component enables simplification of fuel cell, due to efficient movement of water generated at cathode side to anode side.

DESCRIPTION OF DRAWING(S) - The figure shows a structure of membrane-electrode joint component.

anode electrode 1

cation-exchange resin films 2, 3

cathode electrode 4

Dwg. 1/2

TECH JP 2004165047 AUPTX: 20040720

TECHNOLOGY FOCUS - POLYMERS - Preferred Film: The cation-exchange resin film (A) is low molecular weight condensation product of sulfone group-containing alkoxy silane of formula (1), and is reinforced by cloth or nonwoven fabric having thickness of 100 micrometers or less.

R1 = arbitrary organic group having less than 4C alkyl group;

R2 = arbitrary organic group having 1 or more carbon atom;

R3 = divalent organic group having 1 or more carbon atom;

n = 1-3;

m = 0-2; and

m+n = 3.

Preferred Properties: The acidic-radical concentration value (a) of film (2) is less than 800 and greater than or equal to 100. The acidic-radical concentration value (b) of film (3) is lesser than or equal to 2000 and greater than 800. The molecular weight of low molecular weight condensation product is 5000 or less.

The cation-exchange resin film (3) is a fluororesin containing sulfone group and having molecular weight of 5000 or more, and has thickness of 50 micrometers or less.

Preferred Substance: The electrolyte substance used for anode electrode and cathode electrode is used for cation exchange resin of cation exchange resin films (2, 3), respectively.

ABEX JP 2004165047 AUPTX: 20040720

EXAMPLE - Nonwoven glass fabric having thickness of 20 micron and average fiber diameter of 0.5 micron, was baked at 500degreesC. The organic substance in the nonwoven glass fabric was decomposed. Water alcohol solution of trihydroxy silyl propane sulfonic acid was impregnated into the nonwoven fabric, dried at 80degreesC for 10 minutes, and heat-pressed at 130degreesC for 3 minutes. Condensing reaction was performed. A composite film (A) having thickness of 20 micron, acidic-radical concentration of 190 and mean molecular weight of 1500 was obtained. Solid polymer type electrolyte film having thickness of 50 micron and acidic-radical concentration value of 1100, was used as cation exchange resin film (B). Composite film (A) was arranged at anode electrode side and cation-exchange resin film (B) was arranged at cathode electrode side, and laminated. Membrane-electrode joint-component was obtained.

FS CPI EPI

FA AB; GI

MC CPI: A12-E06A; A12-M; L03-E04A; L03-E04B

EPI: X16-C01; X16-E06A

AN 2003-767282 [72] WPIX  
 DNN N2003-614656 DNC C2003-210772  
 TI Polymer electrolyte membrane useful in fuel cells,  
 e.g. methanol fuel cell used in generating electricity  
 and heat, comprises proton conducting hydrocarbon-based polymer membrane  
 with backbone and acidic groups.  
 DC A28 A85 L03 X16  
 IN CAFMEYER, J T; MCGINNIS, V D; RISSER, S M; SAYRE, J R; SCHULTE, M D;  
 VIJAYENDRAN, B; VIJAYENDRAN, B R  
 PA (BATT) BATTELLE MEMORIAL INST; (CAFM-I) CAFMEYER J T; (MCGI-I) MCGINNIS V  
 D; (RISS-I) RISSER S M; (SAYR-I) SAYRE J R; (SCHU-I) SCHULTE M D; (VIJA-I)  
 VIJAYENDRAN B R  
 CYC 103  
 PI WO 2003067691 A2 20030814 (200372)\* EN 40 H01M008-02 <--  
 RW: AT BE BG CH CY CZ DE DK EA EE ES FI FR GB GH GM GR HU IE IT KE LS  
 LU MC MW MZ NL OA PT SD SE SI SK SL SZ TR TZ UG ZM ZW  
 W: AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH CN CO CR CU CZ DE DK  
 DM DZ EC EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR  
 KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ OM PH PL PT  
 RO RU SC SD SE SG SK SL TJ TM TN TR TT TZ UA UG US UZ VC VN YU ZA  
 ZM ZW  
 AU 2003209080 A1 20030902 (200425) H01M008-02 <--  
 EP 1474839 A2 20041110 (200473) EN H01M008-02 <--  
 R: AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LT LU LV  
 MC MK NL PT RO SE SI SK TR  
 US 2005069745 A1 20050331 (200524) H01M008-10 <--  
 JP 2005531646 W 20051020 (200569) 29 C08J005-22  
 ADT WO 2003067691 A2 WO 2003-US3862 20030206; AU 2003209080 A1 AU 2003-209080  
 20030206; EP 1474839 A2 EP 2003-707808 20030206, WO 2003-US3862 20030206;  
 US 2005069745 A1 Provisional US 2002-354717P 20020206, Cont of WO  
 2003-US3862 20030206, US 2004-912590 20040805; JP 2005531646 W JP  
 2003-566925 20030206, WO 2003-US3862 20030206  
 FDT AU 2003209080 A1 Based on WO 2003067691; EP 1474839 A2 Based on WO  
 2003067691; JP 2005531646 W Based on WO 2003067691  
 PRAI US 2002-354717P 20020206; US 2004-912590 20040805  
 IC ICM C08J005-22; H01M008-02; H01M008-10  
 ICS H01B001-06; H01B013-00  
 AB WO2003067691 A UPAB: 20031107  
 NOVELTY - A polymer electrolyte membrane comprises proton conducting  
 hydrocarbon-based polymer membrane. The polymer has a backbone and acidic  
 groups on side chains attached to the backbone.

DETAILED DESCRIPTION - INDEPENDENT CLAIMS are included for:

(1) direct methanol fuel cell comprising polymer  
 electrolyte membrane between anode and cathode, and a supply of methanol  
 fuel fed to the anode; and  
 (2) making polymer electrolyte membrane comprising producing  
 hydrocarbon-based polymer, and forming polymer into proton conducting  
 membrane adapted for use as polymer electrolyte membrane.

USE - Useful in fuel cells, e.g. methanol  
 fuel cell used in generating electricity and heat.

ADVANTAGE - The invention does not lose greater than 5% of its  
 maximum ionic conductivity when operated in fuel cell  
 at 100 deg. C and does not lose greater than 25% of its maximum ionic  
 conductivity when operated in fuel at 120 deg. C (claimed). It can operate  
 at higher temperatures, and has reduced waste management and carbon  
 monoxide issues compared to membranes made with fluorinated polymer  
 operating less than 100 deg. C, thus reduces cost. It retains most of its  
 ionic conductivity at high temperatures. It has separated morphology that  
 does not cause undesirable electro osmotic drag in the membrane, thus  
 eliminating reduced in fuel cell performance.

DESCRIPTION OF DRAWING(S) - The figure shows a representation of two-phase morphological structure in sulfonated side chain polymer of the invention.

Dwg.1/13

TECH WO 2003067691 A2UPTX: 20031107

TECHNOLOGY FOCUS - POLYMERS - Preferred Components: The acidic groups are sulfonate groups. The membrane has phase separated morphological microstructure. The acidic groups are attached to atoms on the side chains. The side chains are 1-12 atoms away from the backbone. The polymer has weight average molecular weight of at least 20000. The polymer is sulfonated polyester ether ketone, sulfonated polyether sulfone, sulfonated polyphenylene oxides, and/or sulfonated lignosulfonate resins. The polymer has a glass transition temperature of at least 100degreesC. The membrane also comprises additive(s). The first additive aids in controlling the morphology of the membrane, high temperature polymers, and sulfonated hydrocarbon-based polymers. The second additive improves membrane by increasing its hydratability and/or its ionic conductivity. The side chains are aliphatic hydrocarbon chains. The assembly also comprises additional membrane electrode assemblies and flow field plates between assemblies to make fuel cell stack. The polymer is sulfonated aromatic polymers, sulfonated alicyclic polymers, or sulfonated (in)organic hybrid polymers. The sulfonated inorganic hybrid polymers are sulfonated siloxane containing hybrids, and/or sulfonated hybrids containing Siloxirane (penta glycidyl ether of cyclo silicon). The membrane comprises basic material with acidic material. The acidic material is acidic hydrocarbon-based oligomers, and/or preferably hydrocarbon-based polymers. The basic material is (substituted) imidazole. The additive is highly hydrated salt. The proton conducting polymer membrane has phase separated morphological microstructure. The membrane has lower electro osmotic drag coefficient than Nafion membrane having the same dimension at the same ionic conductivity and temperature.

ABEX WO 2003067691 A2UPTX: 20031107

EXAMPLE - Dry pellets were taken from an oven and solvent-blended with di methyl acetamide or N-methyl pyrrolidone, salt, e.g. dicesium sulfate, and/or imidazole. The solution used to process membranes on glass panels with drawn-down machine. The solvent laden membranes were placed in vacuum oven at 50-80degreesC and 26 inch Hg for 1-4 hours to pull off the majority of the solvent. The membranes were post-dried in an oven overnight at 50-80degreesC. The final films were homogeneous materials with controlled thickness of 1-20 mils and excellent dry and wet strengths.

FS CPI EPI

FA AB; GI

MC CPI: A10-E12A; A12-E06B; L03-E04A2

EPI: X16-C01C; X16-J01A

=> FILE HCPL

FILE 'HCAPLUS' ENTERED AT 14:47:18 ON 23 JUN 2006

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FUEL (2A) CELL#)

L24        32 SEA FILE=HCAPLUS ABB=ON L15 OR L18 OR L20 OR L23  
 L25        16 SEA FILE=HCAPLUS ABB=ON L24 AND ELECTROCHEM?/SC, SX  
 L26        9 SEA FILE=HCAPLUS ABB=ON L24 AND COMPOSITE  
 L27        9 SEA FILE=HCAPLUS ABB=ON L24 AND ELECTROLYT?  
 L28        18 SEA FILE=HCAPLUS ABB=ON (L25 OR L26 OR L27)  
 L29        14 SEA FILE=HCAPLUS ABB=ON L24 NOT L28  
 L37        2917 SEA FILE=WPIX ABB=ON (?SILANE? OR ?SILOXAN? OR SILICA) (5A) (?SU  
             LFON? OR ?SULFID? OR ?MERCAPT? OR SO3X)  
 L38        1683 SEA FILE=WPIX ABB=ON SILICA(3A) MODIF?  
 L45        21734 SEA FILE=HCAPLUS ABB=ON L37 OR L38  
 L46        162 SEA FILE=HCAPLUS ABB=ON L45 AND (L10 OR NAFION)  
 L47        34 SEA FILE=HCAPLUS ABB=ON L46 AND (COMPOSIT?(3A) ELECTROLYT? OR  
             FUEL(2A) CELL#)  
 L51        48 SEA FILE=HCAPLUS ABB=ON L47 OR L29

=> FILE COMPENDEX

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<20060619/UP>

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<<< SIMULTANEOUS LEFT AND RIGHT TRUNCATION AVAILABLE IN  
 THE BASIC INDEX >>>

=> D QUE L53

L31        8084 SEA FILE=WPIX ABB=ON NAFION OR CATION? (2A) EXCHANG? (4A) (POLYMER  
             ? OR RESIN?)  
 L37        2917 SEA FILE=WPIX ABB=ON (?SILANE? OR ?SILOXAN? OR SILICA) (5A) (?SU  
             LFON? OR ?SULFID? OR ?MERCAPT? OR SO3X)  
 L38        1683 SEA FILE=WPIX ABB=ON SILICA(3A) MODIF?  
 L52        26 SEA FILE=COMPENDEX ABB=ON (L37 OR L38) AND L31  
L53        9 SEA FILE=COMPENDEX ABB=ON L52 AND (COMPOSIT?(3A) ELECTROLYT?  
             OR FUEL(2A) CELL#)

=> FILE JICST

FILE 'JICST-EPLUS' ENTERED AT 14:48:00 ON 23 JUN 2006

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L31        8084 SEA FILE=WPIX ABB=ON NAFION OR CATION? (2A) EXCHANG? (4A) (POLYMER  
             ? OR RESIN?)  
 L37        2917 SEA FILE=WPIX ABB=ON (?SILANE? OR ?SILOXAN? OR SILICA) (5A) (?SU  
             LFON? OR ?SULFID? OR ?MERCAPT? OR SO3X)  
 L38        1683 SEA FILE=WPIX ABB=ON SILICA(3A) MODIF?  
 L52        26 SEA FILE=COMPENDEX ABB=ON (L37 OR L38) AND L31  
L54        1 SEA FILE=JICST-EPLUS ABB=ON L52 AND (COMPOSIT?(3A) ELECTROLYT?  
             OR FUEL(2A) CELL#)

ALEJANDRO 10/627705 06/23/2006

Page 12

=> FILE INSPEC

FILE 'INSPEC' ENTERED AT 14:48:15 ON 23 JUN 2006

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AND HELP CHANGE >>>

=> D QUE L55

L31 8084 SEA FILE=WPIX ABB=ON NAFION OR CATION? (2A) EXCHANG? (4A) (POLYMER  
? OR RESIN?)  
L37 2917 SEA FILE=WPIX ABB=ON (?SILANE? OR ?SILOXAN? OR SILICA) (5A) (?SU  
LFON? OR ?SULFID? OR ?MERCAPT? OR SO3X)  
L38 1683 SEA FILE=WPIX ABB=ON SILICA(3A)MODIF?  
L52 26 SEA FILE=COMPENDEX ABB=ON (L37 OR L38) AND L31  
L55 11 SEA FILE=INSPEC ABB=ON L52 AND (COMPOSIT?(3A)ELECTROLYT? OR  
FUEL (2A)CELL#)

=> DUP REM L51

FILE 'HCAPLUS' ENTERED AT 14:48:32 ON 23 JUN 2006  
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L56 48 DUP REM L51 (0 DUPLICATES REMOVED)

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 PROCESSING COMPLETED FOR L53  
 PROCESSING COMPLETED FOR L54  
 PROCESSING COMPLETED FOR L55  
 L57 57 DUP REM L51 L53 L54 L55 (12 DUPLICATES REMOVED)

=> D L57 ALL HITSTR 1-57

L57 ANSWER 1 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN  
 AN 2006:11258 HCAPLUS  
 DN 144:108786  
 ED Entered STN: 06 Jan 2006  
 TI High efficient and selective process for producing polyethers with low  
 color contamination through dehydrating condensation  
 IN Fujita, Naoko  
 PA Mitsubishi Chemical Corporation, Japan  
 SO PCT Int. Appl., 33 pp.  
 CODEN: PIXXD2  
 DT Patent  
 LA Japanese  
 IC ICM C08G065-34  
 CC 35-5 (Chemistry of Synthetic High Polymers)  
 Section cross-reference(s): 67

FAN.CNT 1

|      | PATENT NO.  | KIND | DATE     | APPLICATION NO. | DATE     |
|------|---|------|----------|-----------------|----------|
| PI   | WO 2006001482   | A1   | 20060105 | WO 2005-JP11980 | 20050629 |
|      | W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH,<br>CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD,<br>GE, GH, GM, HR, HU, ID, IL, IN, IS, KE, KG, KM, KP, KR, KZ, LC,<br>LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG,<br>NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL,<br>SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA,<br>ZM, ZW<br>RW: AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE,<br>IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR, BF, BJ, CF,<br>CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG, BW, GH, GM,<br>KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW, AM, AZ, BY, KG,<br>KZ, MD, RU, TJ, TM |      |          |                 |          |
|      | JP 2006089716   | A2   | 20060406 | JP 2005-188961  | 20050628 |
| PRAI | JP 2004-191567  | A    | 20040629 |                 |          |
|      | JP 2004-191568  | A    | 20040629 |                 |          |
|      | JP 2004-242744  | A    | 20040823 |                 |          |
|      | JP 2004-242745  | A    | 20040823 |                 |          |

CLASS

| PATENT NO.    | CLASS | PATENT FAMILY CLASSIFICATION CODES          |
|---------------|-------|---|
| WO 2006001482 | ICM   | C08G065-34                                  |
|               | IPCI  | C08G0065-34 [ICM,7]; C08G0065-00 [ICM,7,C*] |
| JP 2006089716 | IPCI  | C08G0065-34 [I,A]; C08G0065-00 [I,C*]       |
|               | FTERM | 4J005/AA21; 4J005/BB02                      |

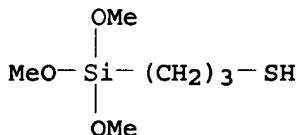
- AB In producing polyether polyols through the dehydrating condensation of polyols, a solid acid catalyst satisfying  $\geq 1$  of the following (i) the acidity function H0 as measured by Hammett's indicator adsorption method is  $>-3$ , (ii) in anal. by temperature programmed ammonia desorption (TPD),  
 the amount of ammonia desorbed at  $100-350^\circ$  is  $\geq 60\%$  of the amount of ammonia desorbed in the whole test region ( $25-700^\circ$ ), and (iii) in a thermogravimetric (TG) anal., the amount of water desorbed at  $32-250^\circ$  is  $\geq 3\%$ . Thus, 20 g 1,3-propane diol purified by distillation and 10 g HSZ 320HOA (zeolite) were heated under nitrogen at  $185 \pm 3^\circ$  for 6 h, distilled off the low b.p. product, cooled at room temperature, 50 g THF was added therein and stirred, filtered, distilled off THF, and vacuum-dried to give a polyether polyol with 1,3-propanediol conversion 61%, Mn 113, polymer selectivity 87%, and no coloration.
- ST high efficient selective process polyether; low color contamination dehydrating condensation; propane diol homopolymer prepn zeolite catalyst
- IT Zeolite HY  
 RL: CAT (Catalyst use); USES (Uses)  
 (HSZ 320HOA, condensation catalysts; high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- IT Ferrierite-type zeolites  
 RL: CAT (Catalyst use); CPS (Chemical process); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses)  
 (HSZ 720KOA, condensation catalyst; high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- IT Ultrastable Y zeolites  
 RL: CAT (Catalyst use); IMF (Industrial manufacture); PREP (Preparation); USES (Uses)  
 (HY, HSZ 330HUA, optionally sodium-exchanged, condensation catalysts; high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- IT Zeolite ZSM-5  
 RL: CAT (Catalyst use); IMF (Industrial manufacture); PREP (Preparation); USES (Uses)  
 (ZSM 5, optionally ammonium-exchanged, condensation catalysts; high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- IT Membranes, nonbiological  
 (condensation catalyst; high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- IT Oxides (inorganic), uses  
 Zeolites (synthetic), uses  
 RL: CAT (Catalyst use); USES (Uses)  
 (condensation catalyst; high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- IT Polyoxyalkylenes, preparation  
 RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
 (high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- IT Polyethers, uses  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (hydroxy-containing; high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)

- IT Condensation reaction catalysts  
(solid acid; high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- IT Silsesquioxanes  
RL: CAT (Catalyst use); IMF (Industrial manufacture); PREP (Preparation); USES (Uses)  
(sulfo-, condensation catalyst; high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- IT Zeolite HY  
RL: CAT (Catalyst use); IMF (Industrial manufacture); PREP (Preparation); USES (Uses)  
(ultrastable, HSZ 330HUA, optionally sodium-exchanged, condensation catalysts; high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- IT 59218-18-7D, Nafion XR 500, metal exchanged  
RL: CAT (Catalyst use); USES (Uses)  
(condensation catalyst; high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- IT 29295-80-5DP, 3-Mercaptopropyltrimethoxysilane homopolymer, oxidized 118473-68-0DP, Nafion NR 50, sodium exchanged 167427-18-1DP, oxidized 357396-46-4DP, X 41-1805, oxidized, sodium salt  
RL: CAT (Catalyst use); IMF (Industrial manufacture); PREP (Preparation); USES (Uses)  
(condensation catalyst; high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- IT 345260-48-2P  
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- IT 110-86-1, Pyridine, reactions  
RL: CAT (Catalyst use); RCT (Reactant); RACT (Reactant or reagent); USES (Uses)  
(modifier for condensation catalyst; high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- IT 6484-52-2, Ammonium nitrate, reactions 7631-99-4, Sodium nitrate, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(reactant for metal-substituted zeolite preparation; high efficient and selective process for producing polyethers with low color contamination through dehydrating condensation)
- RE.CNT 19 THERE ARE 19 CITED REFERENCES AVAILABLE FOR THIS RECORD  
RE
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  - (2) Commonwealth Scientific And Industrial Research Organization; EP 0559739 B1 1994 HCPLUS
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  - (4) Commonwealth Scientific And Industrial Research Organization; US 5403912 A 1994 HCPLUS
  - (5) Commonwealth Scientific And Industrial Research Organization; WO 9209647 A1 1994 HCPLUS
  - (6) E I Du Pont de Nemours & Co; EP 1237835 A2 2003 HCPLUS

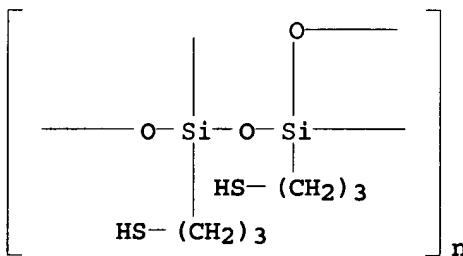
(7) E I Du Pont de Nemours & Co; EP 124686 A1 2003  
 (8) E I Du Pont de Nemours & Co; WO 2001144348 A1 2003  
 (9) E I Du Pont de Nemours & Co; WO 200144150 A1 2003  
 (10) E I Du Pont de Nemours & Co; US 20020007043 A1 2003  
 (11) E I Du Pont de Nemours & Co; JP 2003517071 A 2003  
 (12) E I Du Pont de Nemours & Co; JP 2003517082 A 2003  
 (13) E I Du Pont de Nemours & Co; US 6720459 B2 2003 HCAPLUS  
 (14) Hoechst Ag; EP 0151755 B 1985 HCAPLUS  
 (15) Hoechst Ag; US 4551561 A 1985 HCAPLUS  
 (16) Hoechst Ag; JP 60-156630 A 1985 HCAPLUS  
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 (18) Mitsubishi Chemical Corp; JP 2004182974 A 2004 HCAPLUS  
 (19) Nof Corp; JP 01-125338 A 1989 HCAPLUS  
**IT** 29295-80-5DP, 3-Mercaptopropyltrimethoxysilane homopolymer,  
 oxidized 167427-18-1DP, oxidized  
**RL:** CAT (Catalyst use); IMF (Industrial manufacture); PREP (Preparation);  
**USES (Uses)**  
 (condensation catalyst; high efficient and selective process for  
 producing polyethers with low color contamination through dehydrating  
 condensation)  
**RN** 29295-80-5 HCAPLUS  
**CN** 1-Propanethiol, 3-(trimethoxysilyl)-, homopolymer (9CI) (CA INDEX NAME)

CM 1

CRN 4420-74-0  
 CMF C6 H16 O3 S Si



**RN** 167427-18-1 HCAPLUS  
**CN** Poly[[1,3-bis(3-mercaptopropyl)-1,3:1,3-disiloxanediylidene]-1,3-bis(oxy)]  
 (9CI) (CA INDEX NAME)



L57 ANSWER 2 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN  
**AN** 2006:434548 HCAPLUS  
**ED** Entered STN: 10 May 2006  
**TI** Calcium-binding membrane influence on polymorph and morphology  
 of calcium carbonate formed by biomimetic mineralization  
**AU** Ichikawa, Kazuhiko; Shimomura, Noriyuki  
**CS** Division of Material Science, Graduate School of Environmental Earth

Science, Hokkaido University, Sapporo, 060-0810, Japan  
SO Bulletin of the Chemical Society of Japan (2006), 79(4), 580-587  
CODEN: BCSJA8; ISSN: 0009-2673  
PB Chemical Society of Japan  
DT Journal  
LA English  
CC 12 (Nonmammalian Biochemistry)  
AB The typical conclusions can be drawn as follows: (1) Since vaterite was only formed on calcium-binding poly(L-aspartate)-coated surface between 15 and 35 °C, the carbonic anhydrase (CA)-arising activity of zinc array prevailed the temperature influence on the polymorph of calcium carbonate.  
Time evolution of calcium carbonate formation was enhanced by the zinc array. (2) The calcium carbonate crystallized only on imidazolin- and sulfonate-terminated silane membranes has shown a number of microspheres of 1 μm more or less in diameter (3) The higher temperature and higher pH induced aragonite formation at the sulfonate-terminated Nafion membrane in the presence of the above zinc array. (4) The observed morphol. of aragonite or vaterite was similar to the spherulitic aragonite or vaterite formed by biol. mineralization in marine organisms.

RE.CNT 34 THERE ARE 34 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

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L57 ANSWER 3 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN

AN 2006:592473 HCPLUS

ED Entered STN: 21 Jun 2006  
TI Sulfonic-functionalized heteropolyacid-silica nanoparticles for high temperature operation of a direct methanol fuel cell  
AU Kim, Hyun-Jong; Shul, Yong-Gun; Han, Haksoo  
CS Department of Chemical Engineering, Yonsei University, Seoul, 120-749, S. Korea  
SO Journal of Power Sources (2006), 158(1), 137-142  
CODEN: JPSODZ; ISSN: 0378-7753  
PB Elsevier B.V.  
DT Journal  
LA English  
CC 52 (Electrochemical, Radiational, and Thermal Energy Technology)  
AB Sulfonic-functionalized heteropolyacid-SiO<sub>2</sub> nanoparticles were synthesized by grafting and oxidizing of a thiol-silane compound onto the heteropolyacid-SiO<sub>2</sub> nanoparticle surface. The surface functionalization was confirmed by solid-state NMR spectroscopy. The composite membrane containing the sulfonic-functionalized heteropolyacid-SiO<sub>2</sub> nanoparticles was prepared by blending with Nafion ionomer. TG-DTA anal. showed that the composite membrane was thermally stable up to 290 °C. The DMFC performance of the composite membrane increased the operating temperature from 80 to 200 °C. The function of the sulfonic-functionalized heteropolyacid-SiO<sub>2</sub> nanoparticles was to provide a proton carrier and act as a water reservoir in the composite membrane at elevated temperature. The power d. was 33 mW cm<sup>-2</sup> at 80 °C, 39 mW cm<sup>-2</sup> at 160 °C and 44 mW cm<sup>-2</sup> at 200 °C, resp.

L57 ANSWER 4 OF 57 COMPENDEX COPYRIGHT 2006 EEI on STN  
AN 2006(10):1405 COMPENDEX  
TI Silica nafion modified composite membranes for direct methanol fuel cells.  
AU Garnica Rodriguez, J.I. (ARC Centre for Functional Nanomaterials School of Engineering University of Queensland, Brisbane, QLD 4072, Australia); Dicks, A.L.; Duke, M.C.; Diniz Da Costa, J.C.  
SO Developments in Chemical Engineering and Mineral Processing v 14 n 1-2 2006.p 119-131  
CODEN: DCEPEG ISSN: 0969-1855  
PY 2006  
DT Journal  
TC Theoretical  
LA English  
AB Direct Methanol Fuel Cells (DMFCs) operate by electro-oxidation of methanol and the transport of the protons by means of a polymer electrolyte membrane. Current systems employ Nafion (perfluorosulphonic acid) membranes as the transport media for the protons, which experience a high methanol crossover reducing the efficiency by the oxygen reduction reaction at the anode side of the fuel cell. This work investigated the microstructural modification of Nafion membranes with silica nanoparticles. It was shown that this modification led to reduced methanol crossover, whilst methanol permeability was slightly reduced without compromising the conductivity at the normal DMFC operation temperature (75-80deg C). Methanol uptake was reduced by 55% with the incorporation of the silica nanoparticles into the Nafion matrix. In addition, pure methanol uptake appeared to be less effective than methanol mixtures. These results indicated the presence of water assisted methanol permeation as the hydrophilic sulphonic group and the hydrophobic polymeric backbone of Nafion were sensitive to methanol salvation. 25 Refs.  
CC 817.1 Plastics Products; 804.2 Inorganic Compounds; 702.2 Fuel Cells; 804.1 Organic Compounds; 801.4 Physical Chemistry

CT \*Polymeric membranes; Silica; Microstructure; Fuel cells  
; Methanol  
ST Nafion membranes; Methanol permeation; Methanol salvation

L57 ANSWER 5 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN DUPLICATE 1  
AN 2006:305995 HCAPLUS  
ED Entered STN: 03 Apr 2006  
TI Using silica nanoparticles for modifying  
sulfonated poly(phthalazinone ether ketone) membrane for direct  
methanol fuel cell: A significant improvement on cell  
performance  
AU Su, Yu-Huei; Liu, Ying-Ling; Sun, Yi-Ming; Lai, Juin-Yih; Guiver, Michael  
D.; Gao, Yan  
CS R&D Center for Membrane Technology, Chung Yuan University, Chung-Li,  
32023, Taiwan  
SO Journal of Power Sources (2006), 155(2), 111-117  
CODEN: JPSODZ; ISSN: 0378-7753  
PB Elsevier B.V.  
DT Journal  
LA English  
CC 52 (Electrochemical, Radiational, and Thermal Energy Technology)  
AB Sulfonated poly(phthalazinone ether ketone) (spPEEK) with a degree of  
sulfonation of 1.23 was mixed with silica nanoparticles to form hybrid  
materials for using as proton exchange membranes. The nanoparticles were  
found homogeneously dispersed in the polymer matrix and a high 30 phr  
(parts per hundred resin) loading of silica nanoparticles can be achieved.  
The hybrid membranes exhibited improved swelling behavior, thermal  
stability, and mech. properties. The methanol crossover behavior of the  
membrane was also depressed such that these membranes are suitable for a  
high methanol concentration in feed (3 M) in cell test. The membrane with 5  
phr  
silica nanoparticles showed an open cell potential of 0.6 V and an optimum  
power d. of 52.9 mW cm<sup>-2</sup> at a c.d. of 264.6 mA cm<sup>-2</sup>, which is better than  
the performance of the pristine spPEEK membrane and Nafion 117.

RE.CNT 34 THERE ARE 34 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

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L57 ANSWER 6 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN DUPLICATE 2  
AN 2006:115754 HCAPLUS  
DN 144:372992  
ED Entered STN: 08 Feb 2006  
TI Casting Nafion-sulfonated organo-silica  
nano-composite membranes used in direct methanol fuel  
cells  
AU Li, Chennan; Sun, Gongquan; Ren, Suzhen; Liu, Jin; Wang, Qi; Wu, Zhimou;  
Sun, Hai; Jin, Wei  
CS Direct Alcohol Fuel Cells Laboratory, Dalian Institute of Chemical  
Physics, Chinese Academy of Sciences, Dalian, 116023, Peop. Rep. China  
SO Journal of Membrane Science (2006), 272(1-2), 50-57  
CODEN: JMESDO; ISSN: 0376-7388  
PB Elsevier B.V.  
DT Journal  
LA English  
CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
Section cross-reference(s): 36, 38, 76  
AB Sol-gel derived sulfonated diphenyldimethoxysilane  
(sDDS) with hydrophilic -SO<sub>3</sub>H functional groups were used as the additive  
to reduce the methanol permeability of Nafion. The  
Nafion-sDDS (N-sDDS) nano-composite membranes were prepared by  
mixing Nafion-dimethyl formamide (DMF) solns. with sDDS sol and  
casting to membranes. Swelling weight (SW) test and SEM characterization  
show the phys. properties of the composite membranes and FTIR anal.  
reveals the incorporation of the sDDS monomer within the composite  
membranes. The composite membranes' methanol permeabilities are tested by  
gas chromatog. according to the amount of the sulfonated  
silane. The cell performances of the N-sDDS membrane are  
evaluated and compared with the unsulfonated DDS composite membrane and  
Nafion 117. Compared with the Nafion 117 membrane, the  
nano-composite membrane with the thickness of 125 μm has a lower  
methanol permeability and better single cell performance than the  
unsulfonated DDS composite membrane.  
ST casting Nafion sulfonated organosilica nanocomposite membrane  
methanol fuel cell  
IT Annealing  
    Fuel cell separators  
    Membrane electrodes  
    Nanocomposites  
    Permeability  
    Sulfonation  
        (casting Nafion-sulfonated organo-silica  
        nano-composite membranes used in direct methanol fuel  
        cells)  
IT Carbon black, uses  
RL: DEV (Device component use); TEM (Technical or engineered material  
use); USES (Uses)

(casting Nafion-sulfonated organo-silica  
nano-composite membranes used in direct methanol fuel  
cells)

IT Polysiloxanes, uses

RL: DEV (Device component use); POF (Polymer in formulation); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(di-Ph, sulfonated; casting Nafion-  
sulfonated organo-silica nano-composite membranes  
used in direct methanol fuel cells)

IT Polysiloxanes, uses

RL: DEV (Device component use); POF (Polymer in formulation); RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent); USES (Uses)  
(di-Ph; casting Nafion-sulfonated organo-  
silica nano-composite membranes used in direct methanol  
fuel cells)

IT Polyoxyalkylenes, uses

RL: DEV (Device component use); PEP (Physical, engineering or chemical process); POF (Polymer in formulation); PYP (Physical process); PROC (Process); USES (Uses)  
(fluorine- and sulfo-containing, ionomers; casting Nafion-  
sulfonated organo-silica nano-composite membranes  
used in direct methanol fuel cells)

IT Hybrid organic-inorganic materials

(nanocomposite membrane; casting Nafion-sulfonated  
organo-silica nano-composite membranes used in direct  
methanol fuel cells)

IT Electric current-potential relationship

(of assembled fuel cells; casting Nafion-  
sulfonated organo-silica nano-composite membranes  
used in direct methanol fuel cells)

IT Ion exchange

(of composite membrane; casting Nafion-sulfonated  
organo-silica nano-composite membranes used in direct  
methanol fuel cells)

IT Swelling, physical

(of membranes with methanol; casting Nafion-  
sulfonated organo-silica nano-composite membranes  
used in direct methanol fuel cells)

IT Absorption

(of methanol by membranes; casting Nafion-sulfonated  
organo-silica nano-composite membranes used in direct  
methanol fuel cells)

IT Diffusion

(of methanol through membrane; casting Nafion-  
sulfonated organo-silica nano-composite membranes  
used in direct methanol fuel cells)

IT Membranes, nonbiological

(permselective, composite; casting Nafion-sulfonated  
organo-silica nano-composite membranes used in direct  
methanol fuel cells)

IT Fluoropolymers, uses

RL: DEV (Device component use); PEP (Physical, engineering or chemical process); POF (Polymer in formulation); PYP (Physical process); PROC (Process); USES (Uses)

(polyoxyalkylene-, sulfo-containing, ionomers; casting Nafion-  
sulfonated organo-silica nano-composite membranes  
used in direct methanol fuel cells)

IT Ionomers

RL: DEV (Device component use); PEP (Physical, engineering or chemical

- : process); POF (Polymer in formulation); PYP (Physical process); PROC (Process); USES (Uses)  
(polyoxyalkylenes, fluorine- and sulfo-containing; casting Nafion -sulfonated organo-silica nano-composite membranes used in direct methanol fuel cells)
- IT Fuel cells  
(proton exchange membrane; casting Nafion-sulfonated organo-silica nano-composite membranes used in direct methanol fuel cells)
- IT Ionic conductivity  
(proton, of composite membranes; casting Nafion-sulfonated organo-silica nano-composite membranes used in direct methanol fuel cells)
- IT Polymer blends  
RL: DEV (Device component use); PRP (Properties); USES (Uses)  
(to form nanocomposite membrane; casting Nafion-sulfonated organo-silica nano-composite membranes used in direct methanol fuel cells)
- IT 7440-06-4, Platinum, uses 7440-18-8, Ruthenium, uses  
RL: CAT (Catalyst use); DEV (Device component use); USES (Uses)  
(casting Nafion-sulfonated organo-silica nano-composite membranes used in direct methanol fuel cells)
- IT 882041-29-4P  
RL: DEV (Device component use); POF (Polymer in formulation); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(casting Nafion-sulfonated organo-silica nano-composite membranes used in direct methanol fuel cells)
- IT 121536-62-7P  
RL: DEV (Device component use); POF (Polymer in formulation); RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent); USES (Uses)  
(casting Nafion-sulfonated organo-silica nano-composite membranes used in direct methanol fuel cells)
- IT 66796-30-3, Nafion 117  
RL: DEV (Device component use); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
(casting Nafion-sulfonated organo-silica nano-composite membranes used in direct methanol fuel cells)
- IT 67-56-1, Methanol, uses  
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)  
(casting Nafion-sulfonated organo-silica nano-composite membranes used in direct methanol fuel cells)
- IT 7790-94-5, Chlorosulfonic acid  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(casting Nafion-sulfonated organo-silica nano-composite membranes used in direct methanol fuel cells)
- RE.CNT 26 THERE ARE 26 CITED REFERENCES AVAILABLE FOR THIS RECORD  
RE  
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L57 ANSWER 7 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN  
 AN 2005:1335309 HCAPLUS  
 DN 144:70834  
 ED Entered STN: 23 Dec 2005  
 TI Modified inorganic material with good ion exchange capacity for composite electrolyte membrane and fuel cell and its preparation  
 IN Kim, Hae-Kyoung; Lee, Jae-Sung; Lee, Hyun-Chul; Chang, Hyuk; Rhee, Chang-Houn  
 PA S. Korea  
 SO U.S. Pat. Appl. Publ., 14 pp.  
 CODEN: USXXCO  
 DT Patent  
 LA English  
 IC ICM C08J005-22  
 INCL 429033000; 521027000  
 CC 38-3 (Plastics Fabrication and Uses)  
 Section cross-reference(s): 52  
 FAN.CNT 1

| PATENT NO.         | KIND | DATE     | APPLICATION NO. | DATE     |
|--------------------|------|----------|-----------------|----------|
| PI US 2005282052   | A1   | 20051222 | US 2005-150366  | 20050613 |
| JP 2006016297      | A2   | 20060119 | JP 2005-176146  | 20050616 |
| PRAI KR 2004-45026 | A    | 20040617 |                 |          |

CLASS

| PATENT NO.    | CLASS | PATENT FAMILY CLASSIFICATION CODES  |
|---------------|-------|---|
| US 2005282052 | ICM   | C08J005-22  |
|               | INCL  | 429033000; 521027000  |
|               | IPCI  | C08J0005-22 [ICM,7]; C08J0005-20 [ICM,7,C*]   |
|               | NCL   | 429/033.000   |
| JP 2006016297 | IPCI  | C01F0007-02 [I,A]; C01F0007-00 [I,C*]; H01B0001-06 [I,A]; H01M0008-02 [I,A]; H01M0008-06 [N,A]  |
|               | FTERM | 4G076/AA02; 4G076/AA26; 4G076/AB02; 4G076/AB11; 4G076/BF06; 4G076/CA02; 4G076/CA10; 4G076/DA01; 4G076/DA30; 5G301/CD01; 5G301/CE01; 5H026/AA06; 5H026/AA08; 5H026/BB08; 5H026/BB10; 5H026/CX04; |

5H026/CX05; 5H026/EE12; 5H026/EE18; 5H026/HH00;  
5H026/HH01; 5H027/AA06; 5H027/AA08

- AB The modified inorg. material comprises an inorg. material, and a cation exchanger bonded to the inorg. material. The modified inorg. material is prepared by hydrothermally synthesizing a mixture of a surfactant containing -SH,  
(e.g., 3-Mercaptopropyl trimethoxysilane), an inorg. material precursor (e.g., tris(2-butoxy)aluminum) and water to produce a precipitation; oxidizing the precipitation using an oxidant; and sulfonating the oxidized precipitation
- ST cation exchanger modified inorg material electrolyte membrane; fuel cell composite electrolyte membrane
- IT Cation exchangers  
(acidic; modified inorg. material with good ion exchange capacity for composite electrolyte membrane and fuel cell)
- IT Surfactants  
(bonded or absorbed to oxide; modified inorg. material with good ion exchange capacity for composite electrolyte membrane and fuel cell)
- IT Membranes, nonbiological  
(elec. conductive, electrolyte; modified inorg. material with good ion exchange capacity for composite electrolyte membrane and fuel cell)
- IT Polyoxyalkylenes, uses  
RL: POF (Polymer in formulation); TEM (Technical or engineered material use); USES (Uses)  
(fluorine- and sulfo-containing, ionomers, Nafion; modified inorg. material with good ion exchange capacity for composite electrolyte membrane and fuel cell)
- IT Electrolytes  
(membranes; modified inorg. material with good ion exchange capacity for composite electrolyte membrane and fuel cell)
- IT Fuel cell electrolytes  
Fuel cells  
Oxidizing agents  
(modified inorg. material with good ion exchange capacity for composite electrolyte membrane and fuel cell)
- IT Oxides (inorganic), uses  
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)  
(modified; modified inorg. material with good ion exchange capacity for composite electrolyte membrane and fuel cell)
- IT Fluoropolymers, uses  
RL: POF (Polymer in formulation); TEM (Technical or engineered material use); USES (Uses)  
(polyoxyalkylene-, sulfo-containing, ionomers, Nafion; modified inorg. material with good ion exchange capacity for composite electrolyte membrane and fuel cell)
- IT Ionomers  
RL: POF (Polymer in formulation); TEM (Technical or engineered material use); USES (Uses)  
(polyoxyalkylenes, fluorine- and sulfo-containing, Nafion; modified inorg. material with good ion exchange capacity for

composite electrolyte membrane and fuel cell)

IT Conducting polymers  
 (proton; modified inorg. material with good ion exchange capacity for composite electrolyte membrane and fuel cell)

IT 2269-22-9 63957-70-0, Boehmite  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (modified inorg. material with good ion exchange capacity for composite electrolyte membrane and fuel cell)

IT 7664-93-9, Sulfuric acid, reactions 7722-84-1, Hydrogen peroxide, reactions  
 RL: RGT (Reagent); RACT (Reactant or reagent)  
 (modified inorg. material with good ion exchange capacity for composite electrolyte membrane and fuel cell)

IT 1344-28-1, Aluminum oxide, uses  
 RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)  
 (modified; modified inorg. material with good ion exchange capacity for composite electrolyte membrane and fuel cell)

IT 4420-74-0, 3-Mercaptopropyl trimethoxysilane  
 RL: RCT (Reactant); TEM (Technical or engineered material use); RACT (Reactant or reagent); USES (Uses)  
 (surfactant, bonded or absorbed to oxide; modified inorg. material with good ion exchange capacity for composite electrolyte membrane and fuel cell)

IT 79059-66-8, 3-Sulfopropyltrimethoxysilane  
 RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)  
 (surfactant, oxides modified with; modified inorg. material with good ion exchange capacity for composite electrolyte membrane and fuel cell)

L57 ANSWER 8 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN  
 AN 2005:1078002 HCAPLUS  
 DN 143:369994  
 ED Entered STN: 07 Oct 2005  
 TI Composite polymer electrolytes based on organo-silica hybrid proton conductors for fuel cells  
 IN Narayanan, Sekharipuram R.; Yen, Shiaopin S.  
 PA USA  
 SO U.S. Pat. Appl. Publ., 10 pp.  
 CODEN: USXXCO  
 DT Patent  
 LA English  
 IC ICM H01M008-10  
 INCL 429033000; 252182100  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 38  
 FAN.CNT 1

| PATENT NO.           | KIND | DATE     | APPLICATION NO. | DATE     |
|----------------------|------|----------|-----------------|----------|
| PI US 2005221142     | A1   | 20051006 | US 2005-88060   | 20050323 |
| PRAI US 2004-555627P | P    | 20040323 |                 |          |

CLASS

| PATENT NO.    | CLASS  | PATENT FAMILY CLASSIFICATION CODES  |
|---------------|--|---|
| US 2005221142 | ICM<br>INCL<br>IPCI<br>IPC<br>NCL  | H01M008-10<br>429033000; 252182100<br>H01M0008-10 [ICM,7]<br>H01M0008-10 [I,A]; H01M0008-10 [I,C*]<br>429/033.000 |
| AB            | <b>Composite polymer electrolytes</b> for use in polymer electrolyte membrane fuel cells are disclosed. The electrolytes comprise sulfonated-organo-silica hybrid electrolyte materials formed into a membrane. The sulfonated-organo-silica hybrid electrolyte materials may be formed into a membrane by combining them in solution with Nafion and solution casting the solution slurry to form a membrane. Alternatively, the sulfonated-organo-silica hybrid electrolyte materials may be formed into a membrane by mixing them with an appropriate binder and applying the mixture to a suitable substrate. Also, the sulfonated-organo-silica hybrid electrolyte materials may be formed into a membrane by sheer calendaring a co-precipitate of the sulfonated-organo-silica hybrid electrolyte materials and Teflon. |   |
| ST            | fuel cell composite polymer  |   |
|               | electrolyte; organo silica hybrid proton conductor fuel  |   |
| IT            | <b>Fuel cell electrolytes</b><br>(composite polymer electrolytes based on<br>organo-silica hybrid proton conductors for fuel cells<br>)  |   |
| IT            | <b>Fluoropolymers</b> , uses<br>Glass, uses<br>Polybenzimidazoles<br>Polybenzoxazoles<br>RL: TEM (Technical or engineered material use); USES (Uses)<br>(composite polymer electrolytes based on<br>organo-silica hybrid proton conductors for fuel cells<br>)   |   |
| IT            | <b>Polyoxyalkylenes</b> , uses<br>RL: DEV (Device component use); USES (Uses)<br>(fluorine- and sulfo-containing, ionomers; composite polymer electrolytes based on organo-silica hybrid proton conductors for fuel cells)   |   |
| IT            | <b>Polyketones</b><br>Polysulfones, uses<br>RL: MOA (Modifier or additive use); USES (Uses)<br>(polyether-, sulfonated; composite polymer electrolytes based on organo-silica hybrid proton conductors for fuel cells)   |   |
| IT            | <b>Polyethers</b> , uses<br>RL: MOA (Modifier or additive use); USES (Uses)<br>(polyketone-, sulfonated; composite polymer electrolytes based on organo-silica hybrid proton conductors for fuel cells)  |   |
| IT            | <b>Fuel cells</b><br>(polymer electrolyte; composite polymer electrolytes based on organo-silica hybrid proton conductors for fuel cells)  |   |
| IT            | <b>Fluoropolymers</b> , uses<br>RL: DEV (Device component use); USES (Uses)<br>(polyoxyalkylene-, sulfo-containing, ionomers; composite polymer electrolytes based on organo-silica hybrid proton conductors for fuel cells)   |   |

## IT Ionomers

RL: DEV (Device component use); USES (Uses)  
 (polyoxyalkylenes, fluorine- and sulfo-containing; composite polymer electrolytes based on organo-silica hybrid proton conductors for fuel cells)

## IT Polyethers, uses

RL: MOA (Modifier or additive use); USES (Uses)  
 (polysulfone-, sulfonated; composite polymer electrolytes based on organo-silica hybrid proton conductors for fuel cells)

## IT Polysiloxanes, uses

RL: DEV (Device component use); USES (Uses)  
 (sulfophenylene group-containing; composite polymer electrolytes based on organo-silica hybrid proton conductors for fuel cells)

IT 63747-54-6 88822-94-0 570383-26-5 866186-63-2

RL: MOA (Modifier or additive use); USES (Uses)  
 (composite polymer electrolytes based on organo-silica hybrid proton conductors for fuel cells  
 )

## IT 9002-84-0, Teflon

RL: TEM (Technical or engineered material use); USES (Uses)  
 (latex; composite polymer electrolytes based on organo-silica hybrid proton conductors for fuel cells  
 )

L57 ANSWER 9 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN

AN 2005:1149498 HCPLUS

DN 143:388696

ED Entered STN: 27 Oct 2005

TI Articles having long-lasting antifogging properties

IN Katagiri, Hiroshi; Kawase, Akiko

PA Seiko Epson Corp., Japan

SO Jpn. Kokai Tokkyo Koho, 14 pp.

CODEN: JKXXAF

DT Patent

LA Japanese

IC ICM B32B007-02

ICS C08J007-06; C09K003-00; G02B001-10; G02C007-02; C08L101-00

CC 42-10 (Coatings, Inks, and Related Products)

Section cross-reference(s): 38, 63, 73

FAN.CNT 1

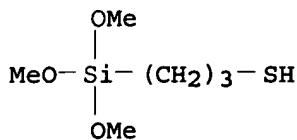
| PATENT NO.          | KIND | DATE     | APPLICATION NO. | DATE     |
|---------------------|------|----------|-----------------|----------|
| PI JP 2005297275    | A2   | 20051027 | JP 2004-114288  | 20040408 |
| PRAI JP 2004-114288 |      | 20040408 |                 |          |

## CLASS

| PATENT NO.    | CLASS | PATENT FAMILY CLASSIFICATION CODES   |
|---------------|-------|--|
| JP 2005297275 | ICM   | B32B007-02   |
|               | ICS   | C08J007-06; C09K003-00; G02B001-10; G02C007-02;<br>C08L101-00  |
|               | IPCI  | B32B0007-02 [ICM,7]; C08J0007-06 [ICS,7]; C08J0007-00<br>[ICS,7,C*]; C09K0003-00 [ICS,7]; G02B0001-10 [ICS,7];<br>G02C0007-02 [ICS,7]; C08L0101-00 [ICS,7]   |
|               | IPCR  | B32B0007-02 [I,A]; B32B0007-02 [I,C*]; C08J0007-00<br>[I,C*]; C08J0007-06 [I,A]; C09K0003-00 [I,A];<br>C09K0003-00 [I,C*]; G02B0001-10 [I,A]; G02B0001-10<br>[I,C*]; G02C0007-02 [I,A]; G02C0007-02 [I,C*] |
|               | FTERM | 2K009/BB11; 2K009/CC42; 2K009/CC47; 2K009/DD02;  |

2K009/DD04; 2K009/DD06; 2K009/EE02; 4F006/AA11;  
 4F006/AA31; 4F006/AB66; 4F006/AB69; 4F006/BA10;  
 4F006/CA05; 4F006/DA04; 4F100/AK52B; 4F100/AT00A;  
 4F100/BA03; 4F100/BA07; 4F100/BA10A; 4F100/BA10C;  
 4F100/CA10C; 4F100/CA18C; 4F100/EH46C; 4F100/GB90;  
 4F100/JB06C; 4F100/JM02B

- AB Substrates having organic membranes containing S on the surfaces are coated with antifogging agents containing anionic surfactants and optionally other surfactants to give the title articles. Thus, 3-mercaptopropyltrimethoxysilane was oxidized and hydrolyzed in aqueous Mn peroxide and passed through a strongly acidic cation exchange resin to give a sulfonic acid solution, which was diluted with EtOH and mixed with Na dilauryl sulfosuccinate to give a treatment solution. A plastic eyeglass lens having a hard coating layer and an antireflective layer was plasma-cleaned, dip-coated with the treatment solution, and kept at 60° for 4 h to form an organic membrane, then a drop of an aqueous solution of Na polyoxyethylene lauryl ether sulfate (Nikkol SBL 4N) was allowed to fall on the lens and wiped to show contact angle to H<sub>2</sub>O ≤ 5° and good durability.
- ST sulfonic acid coating lens antifogging; anionic surfactant coating lens antifogging
- IT Surfactants  
 (anionic; antifogging articles having sulfur-containing organic membrane and anionic surfactant layer)
- IT Eyeglass lenses  
 projection apparatus  
 (antifogging articles having sulfur-containing organic membrane and anionic surfactant layer)
- IT Sulfonic acids, uses  
 RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
 (coating; antifogging articles having sulfur-containing organic membrane and anionic surfactant layer)
- IT Antifogging agents  
 (coatings; antifogging articles having sulfur-containing organic membrane and anionic surfactant layer)
- IT 151-21-3, Nikkol SLS, uses 9004-81-3, Nikkol MYL 10 9004-82-4, Nikkol SBL 4N 59149-04-1D, N-Carboxymethyl-N-hydroxyethylimidazolinium betaine, alkyl derivs. 167678-62-8, Nikkol AM 101  
 RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
 (antifogging agent; antifogging articles having sulfur-containing organic membrane and anionic surfactant layer)
- IT 4420-74-0DP, 3-Mercaptopropyltrimethoxysilane, oxidized and hydrolyzed 189344-76-1DP, oxidized and hydrolyzed  
 RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
 (coating; antifogging articles having sulfur-containing organic membrane and anionic surfactant layer)
- IT 4420-74-0DP, 3-Mercaptopropyltrimethoxysilane, oxidized and hydrolyzed  
 RL: IMF (Industrial manufacture); PRP (Properties); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
 (coating; antifogging articles having sulfur-containing organic membrane and anionic surfactant layer)
- RN 4420-74-0 HCPLUS
- CN 1-Propanethiol, 3-(trimethoxysilyl)- (7CI, 8CI, 9CI) (CA INDEX NAME)



L57 ANSWER 10 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN  
 AN 2005:434349 HCAPLUS  
 DN 143:136197  
 ED Entered STN: 23 May 2005  
 TI Method for modifying proton exchange membrane using the sol-gel process  
       for fuel cell  
 AU Klein, L. C.; Daiko, Y.; Aparicio, M.; Damay, F.  
 CS Ceramic and Materials Engineering, Rutgers University, Piscataway, NJ,  
       08854-8065, USA  
 SO Polymer (2005), 46(12), 4504-4509  
       CODEN: POLMAG; ISSN: 0032-3861  
 PB Elsevier Ltd.  
 DT Journal  
 LA English  
 CC S2-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 AB Over the past 20 years, sol-gel processing has expanded into organic-inorg.  
       hybrid materials. This expansion has benefited from the collaborations  
       between the polymers community and the ceramics community, and the  
       discovery that in many instances sol-gel processing and polymer processing  
       are compatible. An active participant in this field has been Dr James E.  
       Mark [Mark J. E., Heterog Chem Rev 1996;3:307-320], and his  
       accomplishments deserve this tribute. One example, which derives from his  
       work in organically-modified silicates (ORMOSILS), is hybrid membranes for  
       fuel cells. We present some recent progress in  
       synthesis of hybrid membranes involving Nafion. These membranes  
       have been prepared by infiltration and recasting, and contain silicates,  
       phosphosilicates, zirconium phosphosilicates and titanosilicates.  
 ST fuel cell electrolyte proton exchange membrane sol gel  
       modification  
 IT Polyoxyalkylenes, uses  
       RL: DEV (Device component use); USES (Uses)  
           (fluorine- and sulfo-containing, ionomers; modification of proton exchange  
           membranes using sol-gel methods for fuel cell  
           electrolytes)  
 IT Fuel cell electrolytes  
       (modification of proton exchange membranes using sol-gel methods for  
       fuel cell electrolytes)  
 IT Fluoropolymers, uses  
       RL: DEV (Device component use); USES (Uses)  
           (polyoxyalkylene-, sulfo-containing, ionomers; modification of proton  
           exchange membranes using sol-gel methods for fuel  
           cell electrolytes)  
 IT Ionomers  
       RL: DEV (Device component use); USES (Uses)  
           (polyoxyalkylenes, fluorine- and sulfo-containing; modification of proton  
           exchange membranes using sol-gel methods for fuel  
           cell electrolytes)  
 IT 78-10-4 1314-23-4, Zirconia, uses 1314-56-3, Phosphorus oxide (P2O5),  
       uses 7631-86-9, Silica, uses 13463-67-7, Titania, uses  
       RL: DEV (Device component use); USES (Uses)  
           (modification of proton exchange membranes using sol-gel

methods for fuel cell electrolytes)

RE.CNT 35 THERE ARE 35 CITED REFERENCES AVAILABLE FOR THIS RECORD

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storage 2002, V127, P167 HCPLUS
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L57 ANSWER 11 OF 57 COMPENDEX COPYRIGHT 2006 EEI on STN

AN 2006(16):5556 COMPENDEX

TI New conceptual zeolitic direct methanol micro fuel cell

AU Kwan, Siu Ming (Department of Chemical Engineering Hong Kong University of  
Science and Technology, Kowloon, Hong Kong); Yeung, King Lun

MT 05AIChE: 2005 AIChE Annual Meeting and Fall Showcase.

ML Cincinnati, OH, United States

MD 30 Oct 2005-04 Nov 2005

SO AIChE Annual Meeting, Conference Proceedings 2005.p 1832

05AIChE: 2005 AIChE Annual Meeting and Fall Showcase, Conference  
Proceedings

PY 2005

MN 66925

DT Conference Article

TC Experimental

LA English

AB Through miniaturization, microelectronics had given us greater mobility and global inter-connectivity. The need to power the increasingly more sophisticated handheld devices placed a great demand for lightweight power unit that have larger power capacity and usage time to allow the enjoyment of the full benefit of a mobile broadband communication. The micro fuel cell offers a clean and efficient solution to this problem. It has the advantage of high specific and volumetric energy densities, longer life cycle, zero-recharging time and greater flexibility. Methanol is the preferred fuel for micro fuel cells, because of stringent size and weight requirements for these portable devices. The current direct methanol fuel cell (DMFC) employs polymer proton-exchange membrane. Typical perfluorinated sulfonic membranes (e.g., Nafion[registered trademark]) suffer from swelling and loss of mechanical strengths in the presence of methanol leading to a deterioration of membrane structure. Methanol crossover from the anode to the cathode is a major problem that results in catalyst poisoning, hot spots, low open circuit potential and poor fuel cell performance. This can be improved by chemical treatment, modification of polymer chain and addition of copolymers. Sulfonated arylene main chain polymers such as polysulfones or polyetherketones (e.g., SPEEK), borosiloxane polymers and commercial Acidplex[registered trademark] displayed good tolerance for methanol. However, improvements in membrane resistance come at the expense of lower proton conductivity. Several inorganic-organic hybrid materials such as zirconium hydrogen phosphate immobilized in SPEEK, crosslinked polyethylene oxide doped with acidic moieties and pore-filling electrolyte membrane on porous inorganic substrates as well as zeolite-doped Nafion also showed promising results. Recent work by the authors [1] demonstrated that ZSM-5 zeolite membrane is both an effective proton conductor and methanol barrier. Studies suggest that the zeolite membrane structure and chemistry can be further engineered to obtain higher proton flux without jeopardizing the micromembrane's ability to prevent fuel crossover. A micro fuel cell was assembled from ZSM-5 micromembrane and tested using hydrogen and methanol fuels and compared with micro fuel cell using traditional Nation 117 membrane. The results show that zeolite is a promising membrane material for micro fuel cell. 1 Refs.

CC 702.2 Fuel Cells; 804.2 Inorganic Compounds; 804.1 Organic Compounds; 716 Electronic Equipment, Radar, Radio and Television; 802.1 Chemical Plants and Equipment; 931.3 Atomic and Molecular Physics

CT \*Fuel cells; Methanol; Mobile telecommunication

systems; Protons; Polymers; Ion exchange membranes; Zeolites

ST Inter-connectivity; Mobile broadband communication; Volumetric energy densities; Nation 117 membrane

L57 ANSWER 12 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN

AN 2005:208443 HCPLUS

DN 142:449324

ED Entered STN: 10 Mar 2005

TI Nafion/Sulfonated Montmorillonite Composite: A New Concept Electrolyte Membrane for Direct Methanol Fuel Cells

AU Rhee, Chang Houn; Kim, Hae Kyung; Chang, Hyuk; Lee, Jae Sung

CS Department of Chemical Engineering, Pohang University of Science and Technology (POSTECH), Pohang, 790-784, S. Korea

SO Chemistry of Materials (2005), 17(7), 1691-1697

CODEN: CMATEX; ISSN: 0897-4756

PB American Chemical Society

DT Journal

LA English

CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 38, 49, 76

AB An organic species bearing an organic sulfonic acid ( $\text{HSO}_3^-$ ) was grafted onto the

surface of montmorillonite (MMT) by silane condensation, and the composite membranes were cast together with Nafion. The performance of the Nafion/ $\text{HSO}_3$ -MMT composite membranes for direct methanol fuel cells (DMFCs) was evaluated in terms of methanol permeability, proton conductivity, and cell performance. The methanol permeability of the composite membrane decreased dramatically with increasing content of  $\text{HSO}_3$ -MMT in the composite membrane. By rendering proton conductivity to MMT by functionalization with an organic sulfonic acid,

the proton conductivity of the composite membrane was lowered only slightly from that

of pristine Nafion 115. The combination of these effects led to a significant improvement in the performance of DMFCs made with Nafion/ $\text{HSO}_3$ -MMT composite membranes.

ST Nafion sulfonated montmorillonite composite electrolyte membrane methanol fuel cell; MAS NMR XPS cond methanol permeability composite electrolyte membrane

IT Ion exchange  
 (capacity of composite membranes; new electrolyte membrane for direct methanol fuel cells from Nafion/sulfonated montmorillonite composite)

IT Membranes, nonbiological  
 (composite; new electrolyte membrane for direct methanol fuel cells from Nafion /sulfonated montmorillonite composite)

IT Polyoxyalkylenes, uses  
 RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PYP (Physical process); PROC (Process); USES (Uses)  
 (fluorine- and sulfo-containing, ionomers; new electrolyte membrane for direct methanol fuel cells from Nafion /sulfonated montmorillonite composite)

IT Sulfonic acids, uses  
 RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PUR (Purification or recovery); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process); USES (Uses)  
 (montmorillonite-linked; new electrolyte membrane for direct methanol fuel cells from Nafion/sulfonated montmorillonite composite)

IT Composites  
 Condensation reaction  
 Hybrid organic-inorganic materials  
 Membrane electrodes  
 Permeability  
 Polymer electrolytes  
 (new electrolyte membrane for direct methanol fuel cells from Nafion/sulfonated montmorillonite composite)

IT Electric current-potential relationship  
 (of assembled methanol fuel cells; new electrolyte membrane for direct methanol fuel cells from Nafion/sulfonated montmorillonite composite)

IT Carbon fibers, uses  
 RL: DEV (Device component use); TEM (Technical or engineered material use); USES (Uses)  
 (paper; new electrolyte membrane for direct methanol fuel

- cells from Nafion/sulfonated montmorillonite composite)
- IT Fluoropolymers, uses  
RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PYP (Physical process); PROC (Process); USES (Uses)  
(polyoxyalkylene-, sulfo-containing, ionomers; new electrolyte membrane for direct methanol fuel cells from Nafion /sulfonated montmorillonite composite)
- IT Ionomers  
RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PYP (Physical process); PROC (Process); USES (Uses)  
(polyoxyalkylenes, fluorine- and sulfo-containing; new electrolyte membrane for direct methanol fuel cells from Nafion /sulfonated montmorillonite composite)
- IT Electric energy  
(power d. of assembled methanol fuel cells; new electrolyte membrane for direct methanol fuel cells from Nafion/sulfonated montmorillonite composite)
- IT Fuel cells  
(proton exchange membrane; new electrolyte membrane for direct methanol fuel cells from Nafion/sulfonated montmorillonite composite)
- IT Ionic conductivity  
(proton; new electrolyte membrane for direct methanol fuel cells from Nafion/sulfonated montmorillonite composite)
- IT 1318-93-0DP, Montmorillonite, acid-treated 1318-93-0DP, Montmorillonite, acid-treated, reaction products with 3-mercaptopropyltrimethoxysilane  
RL: PRP (Properties); RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)  
(K-10; new electrolyte membrane for direct methanol fuel cells from Nafion/sulfonated montmorillonite composite)
- IT 67-56-1, Methanol, uses  
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)  
(new electrolyte membrane for direct methanol fuel cells from Nafion/sulfonated montmorillonite composite)
- IT 7440-06-4, Platinum, uses 172515-31-0  
RL: DEV (Device component use); USES (Uses)  
(new electrolyte membrane for direct methanol fuel cells from Nafion/sulfonated montmorillonite composite)
- IT 77950-55-1, Nafion 115  
RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); PROC (Process); USES (Uses)  
(new electrolyte membrane for direct methanol fuel cells from Nafion/sulfonated montmorillonite composite)
- IT 1318-93-0DP, Montmorillonite, propylsulfonic acid- functionalized  
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PUR (Purification or recovery); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)  
(new electrolyte membrane for direct methanol fuel cells from Nafion/sulfonated montmorillonite composite)

IT 4420-74-0DP, 3-Mercaptopropyltrimethoxy silane,  
 reaction products with acid-treated montmorillonite  
 RL: PRP (Properties); RCT (Reactant); SPN (Synthetic preparation); PREP  
 (Preparation); RACT (Reactant or reagent)  
 (new electrolyte membrane for direct methanol fuel  
 cells from Nafion/sulfonated montmorillonite  
 composite)

IT 4420-74-0, 3-Mercaptopropyltrimethoxy silane  
 7664-93-9, Sulfuric acid, reactions 7722-84-1, Hydrogen peroxide,  
 reactions  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (new electrolyte membrane for direct methanol fuel  
 cells from Nafion/sulfonated montmorillonite  
 composite)

RE.CNT 34 THERE ARE 34 CITED REFERENCES AVAILABLE FOR THIS RECORD

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IT 77950-55-1, Nafion 115

RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); PROC (Process); USES (Uses)

(new electrolyte membrane for direct methanol fuel  
 cells from Nafion/sulfonated montmorillonite  
 composite)

RN 77950-55-1 HCAPLUS

CN Nafion 115 (9CI) (CA INDEX NAME)

\*\*\* STRUCTURE DIAGRAM IS NOT AVAILABLE \*\*\*

L57 ANSWER 13 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
AN 2005:844196 HCPLUS  
DN 144:90966  
ED Entered STN: 22 Aug 2005  
TI Nano-scale modified inorganic/organic hybrid Materials as proton conductors  
AU Chou, Berryinne; Ghassemi, Hossein; Zawodzinski, Tomas A.  
CS Chemical Engineering Department, Case Western Reserve University, Cleveland, OH, 44106, USA  
SO Preprints of Symposia - American Chemical Society, Division of Fuel Chemistry (2005), 50(2), 650-651  
CODEN: PSADFZ; ISSN: 1521-4648  
PB American Chemical Society, Division of Fuel Chemistry  
DT Journal; (computer optical disk)  
LA English  
CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
Section cross-reference(s): 38, 76  
AB Silica particles were surface-modified with polymers to form proton exchange membranes. Surface modification of silica particles was achieved by a "sultonation" process leading to the production of organic-inorg. hybrid particles with a high IEC value, as high as 2.3 mmol/g. Modified silica particles were blended with sulfonated polyether sulfone copolymers (BPSH) with various degree of sulfonation. The prepared membranes were tested for their proton conductivity and other related properties, such as water uptake. The effect of membrane fabrication conditions on their morphol. and overall performance has been investigated. The proton conductivity of the membranes was measured at different temps. and humidity and the data was used to understand the proton transfer phenomena. The highest proton conductivity for the membranes immersed in water at room temperature was for the highly sulfonated BPSH 60 blended with 10-15 weight% sulfone-modified silica, but this was still less than the polymer alone.  
ST nanoscale inorg org hybrid proton conductor membrane sultonated silica; proton exchange membrane fuel cell sulfonated polyether polysulfone nanocomposite  
IT Cation exchange membranes  
Hybrid organic-inorganic materials  
Ionic conductors  
Nanocomposites  
(nano-scale modified inorg./organic hybrid Materials as proton conductors)  
IT Ionomers  
RL: PRP (Properties)  
(neat and composites with sultone-modified silica;  
nano-scale modified inorg./organic hybrid Materials as proton conductors)  
IT Cation exchange  
(of hybrid polymers; nano-scale modified inorg./organic hybrid Materials as proton conductors)  
IT Microstructure  
(of nanocomposite membranes; nano-scale modified inorg./organic hybrid Materials as proton conductors)  
IT Absorption  
(of water by composite membranes; nano-scale modified inorg./organic hybrid Materials as proton conductors)  
IT Polysulfones, properties

- RL: PRP (Properties)  
(polyether-, aromatic, neat and composites with sultone-modified silica; nano-scale modified inorg./organic hybrid Materials as proton conductors)
- IT Polysulfones, properties  
RL: PRP (Properties)  
(polyether-, aromatic, sulfonated, neat and composites with sultone-modified silica; nano-scale modified inorg./organic hybrid Materials as proton conductors)
- IT Polyethers, properties  
RL: PRP (Properties)  
(polysulfone-, aromatic, neat and composites with sultone-modified silica; nano-scale modified inorg./organic hybrid Materials as proton conductors)
- IT Polyethers, properties  
RL: PRP (Properties)  
(polysulfone-, aromatic, sulfonated, neat and composites with sultone-modified silica; nano-scale modified inorg./organic hybrid Materials as proton conductors)
- IT Ionic conductivity  
(proton; nano-scale modified inorg./organic hybrid Materials as proton conductors)
- IT Ionomers  
RL: PRP (Properties)  
(sulfo-containing, neat and composites with sultone-modified silica; nano-scale modified inorg./organic hybrid Materials as proton conductors)
- IT 267877-35-0  
RL: PRP (Properties)  
(BPSH , neat and composites with sultone-modified silica; nano-scale modified inorg./organic hybrid Materials as proton conductors)
- IT 25608-64-4, 4,4'-Biphenol-4,4'-dichlorodiphenyl sulfone copolymer  
RL: PRP (Properties)  
(BPSH 0, neat and composites with sultone-modified silica; nano-scale modified inorg./organic hybrid Materials as proton conductors)
- IT 7732-18-5, Water, processes  
RL: PEP (Physical, engineering or chemical process); PYP (Physical process); PROC (Process)  
(absorption; nano-scale modified inorg./organic hybrid Materials as proton conductors)
- IT 1120-71-4DP, 1,3-Propane sultone, reaction products with silica  
7631-86-9DP, Silica, reaction products with 1,3-propane sultone  
RL: PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(composites with BPSH; nano-scale modified inorg./organic hybrid Materials as proton conductors)
- IT 7631-86-9, Silica, reactions  
RL: PRP (Properties); RCT (Reactant); RACT (Reactant or reagent)  
(nano-scale modified inorg./organic hybrid Materials as proton conductors)

RE.CNT 2 THERE ARE 2 CITED REFERENCES AVAILABLE FOR THIS RECORD

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L57 ANSWER 14 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN DUPLICATE 3

AN 2005:20059 HCPLUS

DN 142:414311

ED Entered STN: 10 Jan 2005  
TI DBSA-doped PEG/SiO<sub>2</sub> proton-conducting hybrid membranes for low-temperature fuel cell applications  
AU Thangamuthu, R.; Lin, C. W.  
CS Department of Chemical Engineering, National Yunlin University of Science and Technology, Yunlin, Taiwan  
SO Solid State Ionics (2005), 176(5-6), 531-538  
CODEN: SSIOD3; ISSN: 0167-2738  
PB Elsevier B.V.  
DT Journal  
LA English  
CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
Section cross-reference(s): 38  
AB Hybrid membranes were made through a sol-gel process from 3-(triethoxysilyl)propyl isocyanate functionalized by polyethylene glycol (PEG). 4-Dodecylbenzene sulfonic acid (DBSA) was incorporated into the matrix as a p source. DBSA-doped PEG/SiO<sub>2</sub> hybrid membranes exhibit reasonable p conductivity and some have low MeOH permeability which results in higher values of the ratio of p conductivity to MeOH permeability than that of Nafion membranes. Therefore, DBSA-doped PEG/SiO<sub>2</sub> hybrid membranes can reduce the problem associated with MeOH cross-over in direct MeOH fuel cells (DMFCs). The feasibility of these materials as a polymer electrolyte in H<sub>2</sub>/O<sub>2</sub> fuel cells (H<sub>2</sub>/O<sub>2</sub> FC) as well as DMFC is studied with the aim of developing a suitable membrane electrode assembly (MEA) fabrication method for hybrid membranes using the membrane consisting of 80% monophenyl trimethoxysilane (MPh) as SiO<sub>2</sub> phase modifier and 20 weight% DBSA (MPh80DBSA20) as a model material. Fuel cell measurements were carried out at low temperature and at atmospheric pressure. The results are presented and compared with results for similar hybrid membranes and Nafion.  
ST dodecylbenzene sulfonic acid doped PEG silica membrane  
fuel cell  
IT Fuel cell separators  
Fuel cells  
(dodecylbenzene sulfonic acid-doped PEG/SiO<sub>2</sub> proton-conducting hybrid membranes for low-temperature fuel cells)  
IT Ionic conductors  
(protonic; dodecylbenzene sulfonic acid-doped PEG/SiO<sub>2</sub> proton-conducting hybrid membranes for low-temperature fuel cells)  
IT 676260-46-1  
RL: DEV (Device component use); USES (Uses)  
(dodecylbenzene sulfonic acid-doped PEG/SiO<sub>2</sub> proton-conducting hybrid membranes for low-temperature fuel cells)  
IT 121-65-3, 4-Dodecylbenzene sulfonic acid  
RL: DEV (Device component use); MOA (Modifier or additive use); USES (Uses)  
(dodecylbenzene sulfonic acid-doped PEG/SiO<sub>2</sub> proton-conducting hybrid membranes for low-temperature fuel cells)  
RE.CNT 40 THERE ARE 40 CITED REFERENCES AVAILABLE FOR THIS RECORD  
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LS7 ANSWER 15 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
 AN 2005:844091 HCPLUS  
 DN 144:54260  
 ED Entered STN: 22 Aug 2005  
 TI Composite proton exchange membranes  
 AU Liu, Ping; Baker, Gregory L.  
 CS Department of Chemistry, Michigan State University, East Lansing, MI,  
 48823, USA  
 SO Preprints of Symposia - American Chemical Society, Division of Fuel  
 Chemistry (2005), 50(2), 440-441  
 CODEN: PSADFZ; ISSN: 1521-4648  
 PB American Chemical Society, Division of Fuel Chemistry  
 DT Journal; (computer optical disk)  
 LA English  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 38, 76  
 AB Two-component composite polymer electrolyte membranes  
 were prepared using sulfonic acid-modified and sulfonated  
 polystyrene-modified silica. The room temperature proton  
 conductivity of poly(vinylidene fluoride)/modified silica  
 composite membranes were measured at 100 % RH, with an expected increase  
 in conductivity with filler content up to 0.09 S/cm at 50 weight %, higher  
 than the  
 Nafion 117 membrane at the same conditions (0.06 S/cm). Addition of  
 H<sub>3</sub>PO<sub>4</sub> is a common strategy for increasing the protonic conductivity of polymer

- electrolytes. Soaking membranes in various concns. of phosphoric acid resulted in an increase of up to 10 times when using an 8 M solution, with extremely high conductivities even up to 130 °C.
- ST composite proton exchange membrane sulfonated silica phosphoric acid PVDF; proton cond polyvinylidene difluoride composite modified silica phosphoric acid
- IT Membranes, nonbiological  
(composite; improved proton conductivity from composite proton exchange membranes with modified silica and phosphoric acid)
- IT Fuel cell separators  
Polymer electrolytes  
(improved proton conductivity from composite proton exchange membranes with modified silica and phosphoric acid)
- IT Fluoropolymers, uses  
RL: DEV (Device component use); USES (Uses)  
(improved proton conductivity from composite proton exchange membranes with modified silica and phosphoric acid)
- IT Fuel cells  
(polymer electrolyte, membranes for; improved proton conductivity from composite proton exchange membranes with modified silica and phosphoric acid)
- IT Ionic conductivity  
(proton; improved proton conductivity from composite proton exchange membranes  
with modified silica and phosphoric acid)
- IT 7664-38-2, Phosphoric acid, processes  
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); PROC (Process)  
(composite membranes doped with; improved proton conductivity from composite proton exchange membranes with modified silica and phosphoric acid)
- IT 24937-79-9, Polyvinylidene difluoride  
RL: DEV (Device component use); USES (Uses)  
(composites with modified silicas, and also doped with phosphoric acid;  
improved proton conductivity from composite proton exchange membranes with modified silica and phosphoric acid)
- IT 9003-53-6D, Polystyrene, reaction products with silica, sulfonated  
RL: DEV (Device component use); USES (Uses)  
(composites with poly(vinylidene fluoride), and also doped with phosphoric acid; improved proton conductivity from composite proton exchange membranes with modified silica and phosphoric acid)
- IT 7631-86-9DP, Silica, reaction products with polystyrene, sulfonated  
RL: DEV (Device component use); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(composites with poly(vinylidene fluoride), and also doped with phosphoric acid; improved proton conductivity from composite proton exchange membranes with modified silica and phosphoric acid)
- IT 66796-30-3, Nafion 117  
RL: PRP (Properties)  
(improved proton conductivity from composite proton exchange membranes with modified silica and phosphoric acid)
- RE.CNT 5 THERE ARE 5 CITED REFERENCES AVAILABLE FOR THIS RECORD  
RE
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(2) Hunt, J; Prepr Pap - Am Chem Soc, Div Fuel Chem 1999, V44, P610 HCPLUS  
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L57 ANSWER 16 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
AN 2005:741752 HCPLUS  
ED Entered STN: 12 Aug 2005  
TI Development of Nafion-/SiO<sub>2</sub>/phosphotungstic acid nanocomposite membranes for high temperature proton exchange membrane fuel cells  
AU Liu, Yuxiu; Kunz, H. Russell; Fenton, James M.; Zhu, Lei  
CS Polymer Program, Institute of Materials Science and Department of Chemical Engineering, University of Connecticut, Storrs, CT, 06269, USA  
SO Abstracts of Papers, 230th ACS National Meeting, Washington, DC, United States, Aug. 28-Sept. 1, 2005 (2005), PMSE-414 Publisher: American Chemical Society, Washington, D. C.  
CODEN: 69HFCL  
DT Conference; Meeting Abstract; (computer optical disk)  
LA English  
AB Research has been conducted to improve the conductivity of Nafion-based nanocomposite membranes for proton exchange membrane (PEM) fuel cells at high temperature and low relative humidity. 3-Aminopropyl triethoxysilane (APTES) modified mesoporous silica (SBA-15) was used to immobilize phosphotungstic acid (PTA) through ionic complexation processes. These composites were denoted as SAP. Thermogravimetric anal. (TGA) was used to determine the APTES functionalization ratio and PTA immobilization percentage. TGA results indicated that PTA was successfully immobilized, and the highest loading on porous silica was ca. 67 weight%. Nafion- membranes with different SAP contents (denoted as NSAP) were cast from 5 weight% ethanol solution at 70 °C. Small-angle X-ray scattering results on the SAP composites revealed hexagonal cylinder morphol., which was further confirmed by transmission electron microscopy. DC conductivity measurements at various temps. and relative humidities showed slightly higher conductivity for the NSAP membranes than the recast Nafion- membrane.

L57 ANSWER 17 OF 57 INSPEC (C) 2006 IET on STN  
AN 2005:8558785 INSPEC DN A2005-20-8630G-014; B2005-10-8410G-057  
TI Polymer electrolyte membranes applied to low temperature fuel cells  
AU Yu Shou-geng (Kunming Inst. of Precious Metals, Kunming Yunnan, China)  
SO Chinese Journal of Power Sources (May 2005), vol.29, no.5, p. 329-32, 24 refs.  
CODEN: DIJIFT, ISSN: 1002-087X  
SICI: 1002-087X(200505)29:5L.329:PEMA;1-Z  
Published by: Tianjin Inst. Power Sources, China  
DT Journal  
TC Practical; Experimental  
CY China  
LA Chinese  
AB Polymer electrolyte membrane is a heart of low temperature fuel cell. The status of perfluorosulphonic acid membranes such as commercial Nafion.RTM. membranes, organic/inorganic composite membranes, and low-cost polymer membranes were summarized in this review, including modified Nafion.RTM. membranes of decreased the cross-over of methanol, sulfonated polyetherketone composite membranes of modified with organic silane or ZrO<sub>2</sub>/Zr (HPO<sub>4</sub>)<sub>2</sub>, poly [aryloxyphosphazenes] membranes of functionalized with phenyl phosphonic acid, and as two novel classes of materials for use in fuel cells: poly[sil-sesquioxane] hybrid membranes of bridged with octane and sulfonated poly(phthalazinones) membranes, also concerning a physical model about membrane structure is a function of water uptake, on which Schroeder's paradox can be explained: water can infiltrate and

expand the channels between clusters in the membrane, but water vapor cannot condense in them and expand them

CC A8630G Fuel cells; A8265F Film and membrane processes; ion exchange; dialysis; osmosis, electro-osmosis; B8410G Fuel cells; B0550 Composite materials (engineering materials science)

CT organic-inorganic hybrid materials; proton exchange membrane fuel cells

ST polymer electrolyte membranes; fuel cells; perfluorosulphonic acid membranes; Nafion membranes; organic-inorganic composite membranes; sulfonated polyetherketone composite membranes; organic silane; poly [aryloxyphosphazenes] membranes; phenyl phosphonic acid; poly[silsesquioxane] hybrid membranes; membrane structure; Schroeder's paradox; membrane clusters

ET O\*Zr; ZrO<sub>2</sub>; Zr cp; cp; O cp; H\*O\*P; (HPO<sub>4</sub>)<sub>2</sub>; H cp; P cp

L57 ANSWER 18 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN  
 AN 2005:1277850 HCAPLUS  
 ED Entered STN: 06 Dec 2005  
 TI **Nafion-sulfonated organic silane proton conductive composite membranes with low methanol permeation**  
 AU Li, Chennan; Liang, Zhenxing; Ren, Suzhen; Wang, Qi; Wu, Zhimou; Xin, Qin; Sun, Gongquan  
 CS Direct Alcohol Fuel Cells Laboratory, Dalian Institute of Chemical Physics, Chinese Academy of Sciences, Dalian, 116023, Peop. Rep. China  
 SO Processing and Fabrication of Advanced Materials XIII, Proceedings of a Conference, 13th, Singapore, Singapore, Dec. 6-8, 2004 (2005), Meeting Date 2004, Volume 1, 221-239. Editor(s): Gupta, Manoj. Publisher: Stallion Press (S) Pte. Ltd., Singapore, Singapore.  
 CODEN: 69HQFN; ISBN: 981-05-2998-8  
 DT Conference  
 LA English  
 CC 66 (Surface Chemistry and Colloids)  
 AB Sol-gel derived **sulfonated diphenyldimethoxysilane** with hydrophilic -SO<sub>3</sub>H functional groups were used as the additive to reduce the methanol permeability of **Nafion**. The sulfonated composite membrane(N-sDDS) performs better than the unsulfonated monomer with the same amount of silica. N-sDDS composite membranes were prepared by mixing **Nafion**-DMSO solns. with **sulfonated diphenyldimethoxysilane** sol and casting to membranes. SW, EW tests and SEM characterization show the phys. properties of the composite membranes and FT-IR anal. reveals the incorporation of the sDDS monomer within the composite membranes. The methanol permeability and cell performances of the N-sDDS membranes are evaluated and compared with the bare recast **Nafion** membrane and unsulfonated DDS composite membrane. It was found that, compared with the bare recast **Nafion** membrane, the composite membranes have a lower methanol permeability, which is meaningful in the direct methanol fuel cell (DMFCs) than bare recast membrane, and a better single cell performance than the unsulfonated DDS composite membrane.

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L57 ANSWER 19 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN

AN 2005:411915 HCPLUS

DN 143:117953

ED Entered STN: 15 May 2005

TI Polymer nanocomposite membranes for DMFC application

AU Karthikeyan, C. S.; Nunes, S. P.; Prado, L. A. S. A.; Ponce, M. L.; Silva, H.; Ruffmann, B.; Schulte, K.

CS GKSS Research Centre, Institute of Chemistry, Geesthacht, D-21502, Germany

SO Journal of Membrane Science (2005), 254(1-2), 139-146

CODEN: JMESDO; ISSN: 0376-7388

PB Elsevier B.V.

DT Journal

LA English

CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)

Section cross-reference(s): 36, 38, 76

AB Polymer nanocomposite membranes based on sulfonated poly(ether ether ketone) (SPEEK) containing different weight percentages of synthetic nonspherical

nanofillers such as laponite and MCM-41 were prepared and characterized for direct methanol fuel cells (DMFC). Prior to the preparation of the composite membranes, they were modified using organo silanes. There was a decrease in methanol and water permeability with the increasing content of modified laponite and MCM-41. While the membranes containing higher (> 10) weight percentages of silicates displayed lower proton

conductivity values than plain polymer, the lower percentages even showed better

values than the plain. The results are compared with the membranes containing spherical nanofillers, Aerosil and an isotropic silica network system to see the effect of shape of nanofillers on the properties of the composite membranes. Among all shapes, membranes containing silica network had the lowest permeability but they also had poor conductivity values. Much more evident than the effect of form or aspect was the influence of the filler surface modification. In all the cases, organic modification drastically decreased methanol and water permeabilities. A good agreement between the experiment and theory was found for the permeability reduction for membranes containing

lower weight percentages of layered silicates assuming aspect ratio of 125 for laponite.

ST polymer nanocomposite membrane ionomers silicate cond methanol water permeability; proton exchange membrane fuel cell polysilsesquioxane silicate SPEEK network

IT Sulfonation

- (effect on fuel cell performance and methanol permeability; polymer nanocomposite membranes for DMFC application)
- IT Zeolite MCM-41  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(modified and unmodified, reaction products with organosilanes and SPEEK; polymer nanocomposite membranes for DMFC application)
- IT Permeability  
(of water and methanol across membranes; polymer nanocomposite membranes for DMFC application)
- IT Silanes  
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
(organosilanes, reaction products with SPEEK and modified and unmodified silicates; polymer nanocomposite membranes for DMFC application)
- IT Polyketones  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(polyether-, aromatic, sulfonated, reaction products with organosilanes and modified and unmodified silicates; polymer nanocomposite membranes for DMFC application)
- IT Polyethers, uses  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(polyketone-, aromatic, sulfonated, reaction products with organosilanes and modified and unmodified silicates; polymer nanocomposite membranes for DMFC application)
- IT Ceramers  
(polymer nanocomposite membranes for DMFC application)
- IT Silsesquioxanes  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(polyoxyalkylene-silicate-, 3-aminopropyl- functionalized, SPEEK-containing; polymer nanocomposite membranes for DMFC application)
- IT Silsesquioxanes  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(polyoxyalkylene-silicate-, imidazole- functionalized, SPEEK- containing; polymer nanocomposite membranes for DMFC application)
- IT Fuel cells  
(proton exchange membrane, membrane nanocomposites for; polymer nanocomposite membranes for DMFC application)
- IT Ionic conductivity  
(proton, of membranes; polymer nanocomposite membranes for DMFC application)
- IT Polyoxyalkylenes, uses  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(silicate-silsesquioxane-, 3-aminopropyl- functionalized, SPEEK-containing; polymer nanocomposite membranes for DMFC application)
- IT Polyoxyalkylenes, uses  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(silicate-silsesquioxane-, imidazole- functionalized, SPEEK- containing; polymer nanocomposite membranes for DMFC application)
- IT Glass substrates  
(silylated; polymer nanocomposite membranes for DMFC application)

- IT 2602-34-8  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(GPTES; polymer nanocomposite membranes for DMFC application)
- IT 149394-91-2P  
RL: RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)  
(IGPTES; polymer nanocomposite membranes for DMFC application)
- IT 58068-97-6  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(IPTES; polymer nanocomposite membranes for DMFC application)
- IT 7631-86-9P, Aerosil 380, uses  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(colloidal, reaction products with SPEEK and modified and unmodified silicates; polymer nanocomposite membranes for DMFC application)
- IT 53320-86-8DP, Laponite, reaction products with organosilanes and SPEEK  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(modified and unmodified; polymer nanocomposite membranes for DMFC application)
- IT 31694-16-3  
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)  
(polymer nanocomposite membranes for DMFC application)
- IT 67-56-1, Methanol, processes 7732-18-5, Water, processes  
RL: PEP (Physical, engineering or chemical process); PYP (Physical process); PROC (Process)  
(polymer nanocomposite membranes for DMFC application)
- IT 66796-30-3, Nafion 117  
RL: PRP (Properties)  
(polymer nanocomposite membranes for DMFC application)
- IT 31694-16-3DP, sulfonated, and also reaction products with organosilanes and modified and unmodified silicates  
RL: PRP (Properties); RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)  
(polymer nanocomposite membranes for DMFC application)
- IT 13822-56-5DP, Aminopropyltrimethoxysilane, reaction products with SPEEK and modified and unmodified silicates 149394-91-2DP, reaction products with SPEEK and modified and unmodified silicates  
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
(polymer nanocomposite membranes for DMFC application)
- IT 288-32-4, Imidazole, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(polymer nanocomposite membranes for DMFC application)

RE.CNT 39 THERE ARE 39 CITED REFERENCES AVAILABLE FOR THIS RECORD

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L57 ANSWER 20 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN

AN 2005:738613 HCAPLUS

ED Entered STN: 12 Aug 2005

TI Nano-scale modified inorganic/organic hybrid materials as proton conductors

AU Chou, Berryinne

CS Chemical Engineering Department, CWRU, Cleveland, OH, 44106, USA

SO Abstracts of Papers, 230th ACS National Meeting, Washington, DC, United States, Aug. 28-Sept. 1, 2005 (2005), FUEL-110 Publisher: American Chemical Society, Washington, D. C.

CODEN: 69HFCL

DT Conference; Meeting Abstract; (computer optical disk)

LA English

AB Proton exchange membranes are a key component in the fuel cell system. Various perflurosulfonic polymers have been used to achieve high proton conductivity, such as Nafion, however, only gives good proton conductivity when it is fully hydrated and limits the operating temperature

to no higher than 80oC. Therefore, developing new materials for high temperature fuel cells (exceeding 100oC) is challenging. In this work, the surface modified silica particles are bound with polymers to form proton-exchange membranes. Surface modification of silica particles was achieved by sultonation process leading to the production of organic-inorg. hybrid particles

with a high IEC value as 2.3 mmol/g. Modified silica particles were blended with several polymeric binders with different amts. of silica particles. These membranes were tested for their proton conductivity and other related properties, such as water up-take. The effect of

membrane fabrication condition on their morphol. and overall performance has been investigated.

- L57 ANSWER 21 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
AN 2005:1002708 HCPLUS  
DN 144:215926  
ED Entered STN: 16 Sep 2005  
TI Membrane electrode assemblies based on sol-gel hybrid membranes - A preliminary investigation on fabrication aspects  
AU Thangamuthu, R.; Lin, C. W.  
CS Department of Chemical Engineering, National Yunlin University of Science and Technology, Yunlin, Taiwan  
SO Journal of Power Sources (2005), 150, 48-56  
CODEN: JPSODZ; ISSN: 0378-7753  
PB Elsevier B.V.  
DT Journal  
LA English  
CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
AB This paper reports the preliminary results on fabrication of membrane electrode assemblies (MEA) for proton exchange membrane fuel cells (PEMFC) based on sol-gel hybrid membranes. To identify a suitable method, various fabrication strategies were studied. For this purpose, hybrid membranes made from alkoxy silane-end capped poly(ethylene glycol) (PEG) precursor consisting of monophenyl trimethoxysilane (MPh) as silica phase modifier and 4-dodecylbenzene sulfonic acid (DBSA) as proton source (PEG/SiO<sub>2</sub>/DBSA); and MPh and 12-phosphotungstic acid (PWA) (PEG/SiO<sub>2</sub>/PWA) are used as model compds. For the better interface of MEA, impregnation solns. of similar chemical nature with hybrid membranes were examined. Polarization curves are exclusively used to evaluate the quality of MEA. A maximum c.d. of 80 mA cm<sup>-2</sup>, obtained with hot-pressed MEA, is the highest performance among the five different preparation methods. Good contact between the hybrid membrane as an electrolyte and the catalyst coated carbon cloth as electrodes in the MEA is achieved by coating electrodes as well as membrane with precursor soluble. The flexibility of sol-gel hybrid membranes shows scope for further improvement in performance compared to hybrid membranes from solution-blending. The implications of each preparation methods are analyzed.  
ST fuel cell proton exchange membrane electrode  
fabrication acid doping; poly acid doped silica polyethylene glycol hybrid membrane synthesis  
IT Impregnation  
(electrode fabrication method; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)  
IT Carbon fibers, uses  
RL: DEV (Device component use); TEM (Technical or engineered material use); USES (Uses)  
(fabrics; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)  
IT Polyoxyalkylenes, uses  
RL: DEV (Device component use); USES (Uses)  
(fluorine- and sulfo-containing, ionomers; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)  
IT Electrolytic polarization  
Fuel cell separators  
Hybrid organic-inorganic materials  
Membrane electrodes  
Nanocomposites  
Sol-gel processing

- (membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT Fluoropolymers, uses  
RL: DEV (Device component use); USES (Uses)  
(membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT Carbon black, uses  
RL: DEV (Device component use); TEM (Technical or engineered material use); USES (Uses)  
(membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT Polyoxyalkylenes, uses  
RL: CPS (Chemical process); DEV (Device component use); PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)  
(nanocomposites containing silica and; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT Electric current-potential relationship  
(of assembled fuel cells with electrodes, fabrication method effects on; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT Fluoropolymers, uses  
RL: DEV (Device component use); USES (Uses)  
(polyoxyalkylene-, sulfo-containing, ionomers; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT Polysiloxanes, uses  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(polyoxyalkylene-polyurethane-; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT Polyurethanes, uses  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(polyoxyalkylene-siloxane-; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT Ionomers  
RL: DEV (Device component use); USES (Uses)  
(polyoxyalkylenes, fluorine- and sulfo-containing; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT Polyoxyalkylenes, uses  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(polyurethane-siloxane-; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT Fuel cells  
(proton exchange membrane; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT Ionic conductivity  
(proton; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT Ionic conductors  
(protonic; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)

- IT Molding of plastics and rubbers  
(thermal compression, electrode fabrication method; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT Current density  
(vs. cell voltage, electrode fabrication effects on; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT 9002-89-5, Poly(vinylalcohol)  
RL: DEV (Device component use); PRP (Properties); USES (Uses)  
(12-phosphotungstic acid-doped; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT 1343-93-7, 12-Phosphotungstic acid  
RL: DEV (Device component use); MOA (Modifier or additive use); PEP (Physical, engineering or chemical process); PYP (Physical process); PROC (Process); USES (Uses)  
(PEO/silica hybrid polymer doped with, nanocomposite; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT 9002-84-0, Polytetrafluoroethylene  
RL: DEV (Device component use); USES (Uses)  
(binder; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT 178884-92-9P  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(doped with 12-phosphotungstic acid or phenyltrimethoxysilane, nanocomposites; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT 676260-46-1P  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(doped with 4-dodecylbenzenesulfonic acid or 12-phosphotungstic acid, nanocomposite; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT 7440-06-4, Platinum, uses  
RL: CAT (Catalyst use); USES (Uses)  
(membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT 7440-18-8, Ruthenium, uses  
RL: CAT (Catalyst use); DEV (Device component use); USES (Uses)  
(membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT 67-56-1, Methanol, uses  
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PYP (Physical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)  
(membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT 77950-55-1, Nafion 115  
RL: DEV (Device component use); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
(membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on fabrication aspects)
- IT 2996-92-1, Phenyltrimethoxysilane  
RL: DEV (Device component use); MOA (Modifier or additive use); RCT (Reactant); RACT (Reactant or reagent); USES (Uses)  
(proton conducting membranes containing; membrane electrode assemblies based on sol-gel hybrid membranes - preliminary investigation on

fabrication aspects)

IT 121-65-3, 4-Dodecylbenzenesulfonic acid  
 RL: DEV (Device component use); MOA (Modifier or additive use); PEP  
 (Physical, engineering or chemical process); PYP (Physical process); PROC  
 (Process); USES (Uses)  
 (proton conducting membranes doped with, nanocomposite; membrane  
 electrode assemblies based on sol-gel hybrid membranes - preliminary  
 investigation on fabrication aspects)

RE.CNT 33 THERE ARE 33 CITED REFERENCES AVAILABLE FOR THIS RECORD

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IT 77950-55-1, Nafion 115

RL: DEV (Device component use); PRP (Properties); TEM (Technical or  
 engineered material use); USES (Uses)

(membrane electrode assemblies based on sol-gel hybrid membranes -  
 preliminary investigation on fabrication aspects)

RN 77950-55-1 HCAPLUS

CN Nafion 115 (9CI) (CA INDEX NAME)

\*\*\* STRUCTURE DIAGRAM IS NOT AVAILABLE \*\*\*

L57 ANSWER 22 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN  
 AN 2005:738509 HCAPLUS  
 ED Entered STN: 12 Aug 2005  
 TI Composite proton exchange membranes  
 AU Liu, Ping; Baker, Gregory L.

CS Department of Chemistry, Michigan State University, East Lansing, MI, 48824, USA  
 SO Abstracts of Papers, 230th ACS National Meeting, Washington, DC, United States, Aug. 28-Sept. 1, 2005 (2005), FUEL-005 Publisher: American Chemical Society, Washington, D. C.  
 CODEN: 69HFCL  
 DT Conference; Meeting Abstract; (computer optical disk)  
 LA English  
 AB The proton exchange membrane is one of the most important components of PEM fuel cells. Nafion- has long been the prototype membrane material, but its widespread application is limited by high cost and poor high temperature performance. One approach to low cost proton conducting membranes is the preparation of bi-continuous composite materials that combine a proton conducting phase with an insulating phase that provides mech. stability. We decorated the surface of silica particles with sulfonic acids and prepared composite membranes by dispersing the particles in a poly(vinylidene fluoride) (PVDF) matrix. The particles form networks that might be thought of as a crude analog of the channel structure believed to be important proton conductivity in Nafion. The membranes are highly conductive, with room temperature conductivities of 0.06 S/cm. When soaked in 8M H<sub>3</sub>PO<sub>4</sub>, membranes containing 50% silica had conductivities of 0.9 S/cm at 130 °C.

L57 ANSWER 23 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
 AN 2004:701136 HCPLUS  
 DN 141:228099  
 ED Entered STN: 27 Aug 2004  
 TI Composite electrolyte membrane and fuel cell which uses the membrane  
 IN Cho, Joo Hee; Park, Chan Ho  
 PA Samsung SDI Co., Ltd., S. Korea  
 SO Jpn. Kokai Tokkyo Koho, 12 pp.  
 CODEN: JKXXAF  
 DT Patent  
 LA Japanese  
 IC ICM H01M008-02  
 ICS H01B001-06; H01M008-10  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 FAN.CNT 1

| PATENT NO.        | KIND | DATE     | APPLICATION NO.       | DATE     |
|-------------------|------|----------|-----------------------|----------|
| PI JP 2004241391  | A2   | 20040826 | JP 2004-30823         | 20040206 |
| CN 1519970        | A    | 20040811 | CN 2003-147567        | 20030724 |
| US 2005175880     | A1   | 20050811 | <u>US 2003-627705</u> | 20030728 |
| PRAI KR 2003-8007 | A    | 20030208 |                       |          |

## CLASS

| PATENT NO.    | CLASS | PATENT FAMILY CLASSIFICATION CODES  |
|---------------|-------|---|
| JP 2004241391 | ICM   | H01M008-02  |
|               | ICS   | H01B001-06; H01M008-10  |
|               | IPCI  | H01M0008-02 [ICM,7]; H01B0001-06 [ICS,7]; H01M0008-10 [ICS,7]   |
|               | IPCR  | C08J0005-20 [I,C*]; C08J0005-22 [I,A]; H01B0001-06 [I,A]; H01B0001-06 [I,C*]; H01M0008-02 [I,A]; H01M0008-02 [I,C*]; H01M0008-10 [I,A]; H01M0008-10 [I,C*]; H01M0010-36 [I,C*]; H01M0010-40 [I,A] |
|               | FTERM | 5G301/CA30; 5G301/CD01; 5H026/AA06; 5H026/CX04; 5H026/EE12; 5H026/EE18; 5H026/EE19; 5H026/HH01; 5H026/HH05  |
| CN 1519970    | IPCI  | H01M0008-02 [ICM,7]; H01M0008-10 [ICS,7]  |

IPCR C08J0005-20 [I,C\*]; C08J0005-22 [I,A]; H01B0001-06  
 [I,A]; H01B0001-06 [I,C\*]; H01M0008-02 [I,A];  
 H01M0008-02 [I,C\*]; H01M0008-10 [I,A]; H01M0008-10  
 [I,C\*]; H01M0010-36 [I,C\*]; H01M0010-40 [I,A]  
 ECLA H01M008/02E2; H01M008/10E2  
 US 2005175880 IPCI H01M0008-10 [ICM,7]; H01M0010-40 [ICS,7]; H01M0010-36  
 [ICS,7,C\*]; C08J0005-22 [ICS,7]; C08J0005-20 [ICS,7,C\*]  
 IPCR C08J0005-20 [I,C\*]; C08J0005-22 [I,A]; H01B0001-06  
 [I,A]; H01B0001-06 [I,C\*]; H01M0008-02 [I,A];  
 H01M0008-02 [I,C\*]; H01M0008-10 [I,A]; H01M0008-10  
 [I,C\*]; H01M0010-36 [I,C\*]; H01M0010-40 [I,A]  
 NCL 429/033.000  
 ECLA H01M008/02E2; H01M008/10E2

AB The membrane contains a modified silica, obtained by bonding a 1st substituent: R1-SO<sub>3</sub>X (R1 = C<sub>2</sub>-7 alkylene group; and X = H or alkali metal) and a 2nd substituent: R<sub>2</sub>-S-S-R<sub>3</sub> (R<sub>2</sub>, R<sub>3</sub> = C<sub>2</sub>-7 alkylene group) to Si atoms, and a polymer containing a cation exchange group. The fuel cell has the above electrolyte between a cathode and an anode.  
 ST fuel cell electrolyte membrane modified silica polymer; electrolyte membrane modified silica cation exchanger group contg polymer  
 IT Fuel cell electrolytes  
 (composite electrolyte membranes having modified silica and cation exchange group containing polymers for fuel cells)  
 IT 2373-23-1D, Dioctyl sulfosuccinate, reaction product with Nafion 115 and 3-Pr trimethoxy mercaptosilane 4420-74-0D, reaction product with Nafion 115 and dioctyl sulfosuccinate  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (composite electrolyte membranes having modified silica and cation exchange group containing polymers for fuel cells)  
 IT 77950-55-1, Nafion 115  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (reaction product with 3-Pr trimethoxy mercaptosilane and dioctyl sulfosuccinate; composite electrolyte membranes having modified silica and cation exchange group containing polymers for fuel cells)  
 IT 77950-55-1, Nafion 115  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (reaction product with 3-Pr trimethoxy mercaptosilane and dioctyl sulfosuccinate; composite electrolyte membranes having modified silica and cation exchange group containing polymers for fuel cells)  
 RN 77950-55-1 HCPLUS  
 CN Nafion 115 (9CI) (CA INDEX NAME)

\*\*\* STRUCTURE DIAGRAM IS NOT AVAILABLE \*\*\*

L57 ANSWER 24 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
 AN 2004:474757 HCPLUS  
 DN 141:9727  
 ED Entered STN: 11 Jun 2004  
 TI Electrode-electrolyte laminate and fuel cell using the laminate  
 IN Nakamura, Masanori; Masakado, Akio

PA Sekisui Chemical Co., Ltd., Japan  
 SO Jpn. Kokai Tokkyo Koho, 13 pp.  
 CODEN: JKXXAF  
 DT Patent  
 LA Japanese  
 IC ICM H01M008-02  
 ICS H01M008-10  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 FAN.CNT 1

| PATENT NO.          | KIND | DATE     | APPLICATION NO. | DATE     |
|---------------------|------|----------|-----------------|----------|
| PI JP 2004165047    | A2   | 20040610 | JP 2002-331000  | 20021114 |
| PRAI JP 2002-331000 |      | 20021114 |                 |          |

## CLASS

| PATENT NO.    | CLASS   | PATENT FAMILY CLASSIFICATION CODES |
|---------------|---|------------------------------------|
| JP 2004165047 | ICM H01M008-02<br>ICS H01M008-10<br>IPCI H01M0008-02 [ICM,7]; H01M0008-10 [ICS,7]<br>IPCR H01M0008-02 [I,A]; H01M0008-02 [I,C*]; H01M0008-10 [I,A]; H01M0008-10 [I,C*]<br>FTERM 5H026/AA06; 5H026/CX03; 5H026/CX05; 5H026/EE18;<br>5H026/EE19; 5H026/HH00; 5H026/HH03 |                                    |

OS MARPAT 141:9727

AB The laminate has a cathode and an anode on the opposite sides of a cation exchanger membrane, where the membrane has a cathode side film and an anode side film, with the cathode side film having a higher acid group concentration than the anode side film. Preferably, the anode side film is a low

mol. weight condensate of a sulfonated alkoxy silane,  
 $(R1O)_nSi(R2)_mR_3SO_3H$  [R1 = C $\leq$ 4 alkyl, R2 = C $\geq$ 1 organic group, R3 = C $\geq$ 1 bivalent organic group, n = integer 1-3, m = integer 0-2, and (m+n) = 3]; and the cathode side film is a sulfonated fluoropolymer having mol. weight  $\geq$ 5000.

ST fuel cell cation exchanger electrode electrolyte laminate; sulfonated alkoxy silane fuel cell electrolyte laminate; fluoropolymer sulfonated fuel cell electrolyte laminate

IT Fuel cell electrolytes  
 (dual cation exchanger electrolyte membranes for fuel cell electrode-electrolyte laminates)

IT 70942-24-4  
 RL: DEV (Device component use); USES (Uses)  
 (condensation homopolymer; dual cation exchanger electrolyte membranes for fuel cell electrode-electrolyte laminates)

IT 163294-14-2, Nafion 112  
 RL: DEV (Device component use); USES (Uses)  
 (dual cation exchanger electrolyte membranes for fuel cell electrode-electrolyte laminates)

L57 ANSWER 25 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN

AN 2004:1005957 HCPLUS

DN 142:135452

ED Entered STN: 23 Nov 2004

TI Organic-Inorganic Hybrid Membrane: Thermally Stable Cation-Exchange Membrane Prepared by the Sol-Gel Method

AU Nagarale, R. K.; Gohil, G. S.; Shahi, Vinod K.; Rangarajan, R.

CS Central Salt Marine Chemicals Research Institute, Bhavnagar, 364002, India

SO Macromolecules (2004), 37(26), 10023-10030

CODEN: MAMOBX; ISSN: 0024-9297

PB American Chemical Society  
DT Journal  
LA English  
CC 37-5 (Plastics Manufacture and Processing)  
Section cross-reference(s): 35, 36

AB Organic-inorg. hybrid membranes based on poly(vinyl alc.)-SiO<sub>2</sub> were prepared under acidic and basic conditions, in which sulfonic acid groups were introduced at the inorg. segment. These membranes were extensively characterized for their morphol., intermol. interactions, thermal and mech. stability, and physicochem. properties using SEM, transmission electron microscopy (TEM), Fourier transform IR (FTIR), thermogravimetric anal. (TGA), differential scanning calorimetry (DSC), dynamic mech. anal. (DMA), and water uptake studies. Schematic models for acid-catalyzed linear weakly polymeric clusters and for base-catalyzed highly branched polymeric clusters were proposed. A higher ion-exchange capacity, permselectivity, and conductivity for the acid-catalyzed hybrid membranes than for the base-catalyzed membranes with the same composition indicated that the former route is suitable for the preparation of ion-exchange membranes. The electrochem. properties of the membrane and the equivalent pore radius were found to be highly dependent on Si content in the membrane phase. It was concluded that a definite compromise between the silica content and the membrane ion-exchange properties is required in order to have an organic-inorg. hybrid cation-exchange membrane. Furthermore, the physicochem. and electrochem. properties of these membranes were comparable to those of Nafion membrane, which suggests that they may be suitable for fuel cell and chlor-alkali applications as a substitute for Nafion membrane.

ST polyvinyl alc silica org inorg hybrid ion exchange membrane; morphol thermal mech physicochem electrochem membrane

IT Ion exchange (capacity; thermally stable organic-inorg. hybrid cation-exchange membrane prepared by sol-gel method)

IT Polymerization catalysts (effect on thermally stable organic-inorg. hybrid cation-exchange membrane prepared by sol-gel method)

IT Sol-gel processing (polymerization; thermally stable organic-inorg. hybrid cation-exchange membrane prepared by sol-gel method)

IT Permeability (selective; thermally stable organic-inorg. hybrid cation-exchange membrane prepared by sol-gel method)

IT Polymerization (sol-gel; thermally stable organic-inorg. hybrid cation-exchange membrane prepared by sol-gel method)

IT Cation exchange membranes

Electric conductivity

Electroosmosis

Glass transition temperature

Hybrid organic-inorganic materials

Polymer morphology

Pore size

Thermal stability (thermally stable organic-inorg. hybrid cation-exchange membrane prepared by sol-gel method)

IT 7732-18-5, Water, processes

RL: PEP (Physical, engineering or chemical process); PYP (Physical process); PROC (Process)

(absorption; thermally stable organic-inorg. hybrid cation-exchange membrane prepared by sol-gel method)

IT 1336-21-6, Ammonia water 7647-01-0, Hydrochloric acid, uses  
RL: CAT (Catalyst use); USES (Uses)

(effect on thermally stable organic-inorg. hybrid cation-exchange membrane prepared by sol-gel method)

IT 7647-14-5, Sodium chloride, processes

RL: PEP (Physical, engineering or chemical process); PYP (Physical process); PROC (Process)

(permselectivity of thermally stable organic-inorg. hybrid cation-exchange membrane prepared by sol-gel method)

IT 827318-74-1DP, oxidized

RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)

(thermally stable organic-inorg. hybrid cation-exchange membrane prepared by sol-gel method)

RE.CNT 40 THERE ARE 40 CITED REFERENCES AVAILABLE FOR THIS RECORD

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IT 827318-74-1DP, oxidized

RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)

(thermally stable organic-inorg. hybrid cation-exchange membrane prepared by sol-gel method)

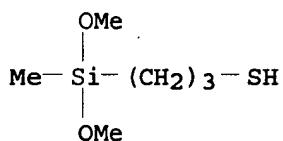
RN 827318-74-1 HCAPLUS

CN Silicic acid (H<sub>4</sub>SiO<sub>4</sub>), tetraethyl ester, polymer with 3-(dimethoxymethylsilyl)-1-propanethiol, ethanol and formaldehyde (9CI) (CA INDEX NAME)

CM 1

CRN 31001-77-1

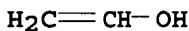
CMF C<sub>6</sub> H<sub>16</sub> O<sub>2</sub> S Si



CM 2

CRN 557-75-5

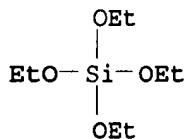
CMF C<sub>2</sub> H<sub>4</sub> O



CM 3

CRN 78-10-4

CMF C<sub>8</sub> H<sub>20</sub> O<sub>4</sub> Si



CM 4

CRN 50-00-0

CMF C H<sub>2</sub> O



L57 ANSWER 26 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN  
AN 2004:592556 HCAPLUS

DN 141:280272  
ED Entered STN: 26 Jul 2004  
TI Organic-inorganic composite membranes as addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs)  
AU Kim, You Mee; Choi, Seong Ho; Lee, Heung Chan; Hong, Ming Zi; Kim, Keon; Lee, Ho-In  
CS Division of Chemistry and Molecular Engineering, Korea University, SungBuk-Ku, Seoul, 136-701, S. Korea  
SO Electrochimica Acta (2004), 49(26), 4787-4796  
CODEN: ELCAAV; ISSN: 0013-4686  
PB Elsevier B.V.  
DT Journal  
LA English  
CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
Section cross-reference(s): 38, 76  
AB Organic-inorg. composite membranes for operation >100° in polymer electrolyte membrane fuel cells (PEMFCs) were prepared, characterized and cell-tested. Composite membranes were obtained by mixing organic polymers, which have a SO<sub>3</sub>H group as a proton conductor with inorg. material, SiO<sub>2</sub>, using the sol-gel process. An Electron probe micro analyzer (electron-probe microanal.) was used to show the homogeneous and uniform distribution of SiO<sub>2</sub>. The physicochem. properties of all membranes were studied regarding their tensile strength, water uptake and thermogravimetric analyzer (TGA). Due to a higher water uptake and thermal stability of composite membranes, the cell performances at high temps. >100 °C, were improved. The SiOH group in the composite membrane was shown to play a major role in capturing water strongly and maintaining proton conductivity even at high temperature. Also, the fuel cell performance of organic-inorg. composite membranes was superior to that of the Nafion membrane at high c.d. over all ranges of temperature  
ST org silica composite membrane polymer electrolyte fuel cell membrane; proton cond sulfonated arom fluorinated polyether silica composite membrane  
IT Polyethers, preparation  
RL: RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)  
(aromatic, fluorine-containing, sulfonated; organic-inorg. composite membranes  
with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))  
IT Polyethers, preparation  
RL: RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)  
(aromatic, fluorine-containing; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))  
IT Membranes, nonbiological  
(composite; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))  
IT Polyoxyalkylenes, properties  
RL: PRP (Properties)  
(fluorine- and sulfo-containing, ionomers; organic-inorg. composite membranes  
with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))

- IT Electric current-potential relationship  
(of assembled fuel cells; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT Thermal stability  
(of composite membranes; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT Fuel cell electrolytes
- Fuel cells
- Hybrid organic-inorganic materials
- Membrane electrodes
- Tensile strength  
(organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT Fluoropolymers, preparation
- RL: RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)  
(polyether-, aromatic, sulfonated; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT Fluoropolymers, preparation
- RL: RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)  
(polyether-, aromatic; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs)
- IT Fluoropolymers, properties
- RL: PRP (Properties)  
(polyoxyalkylene-, sulfo-containing, ionomers; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT Ionomers
- RL: PRP (Properties)  
(polyoxyalkylenes, fluorine- and sulfo-containing; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT Ionic conductivity  
(proton; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT Polymer electrolytes  
(silica composite with sulfonated fluorinated aromatic polyether; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT Swelling, physical  
(with water sorption; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT 7732-18-5, Water, processes
- RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); PROC (Process)  
(absorption; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))

- IT 7440-44-0, Carbon, uses  
RL: DEV (Device component use); USES (Uses)  
(electrode composite with Pt; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane  
fuel cells (PEMFCs))
- IT 7440-06-4, Platinum, uses  
RL: DEV (Device component use); USES (Uses)  
(electrode composite with carbon; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane  
fuel cells (PEMFCs))
- IT 7664-93-9, Sulfuric acid, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(fuming; organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT 584-08-7, Potassium carbonate  
RL: CAT (Catalyst use); USES (Uses)  
(organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT 66796-30-3, Nafion 117  
RL: DEV (Device component use); USES (Uses)  
(organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT 7631-86-9P, Silica, uses  
RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process); USES (Uses)  
(organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT 136875-49-5DP, Decafluorobiphenyl-4,4'-(hexafluoroisopropylidene)diphenol copolymer, sulfonated derivs.  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT 64-19-7, Acetic acid, uses  
RL: MOA (Modifier or additive use); USES (Uses)  
(organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT 136835-79-5P, Decafluorobiphenyl-4,4'-(hexafluoroisopropylidene)diphenol copolymer, sru 136875-49-5P, Decafluorobiphenyl-4,4'-(hexafluoroisopropylidene)diphenol copolymer  
RL: PRP (Properties); RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)  
(organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))
- IT 1333-74-0, Hydrogen, uses  
RL: RCT (Reactant); TEM (Technical or engineered material use); RACT (Reactant or reagent); USES (Uses)  
(organic-inorg. composite membranes with addition of SiO<sub>2</sub> for high temperature-operation in polymer electrolyte membrane fuel cells (PEMFCs))

RE.CNT 24 THERE ARE 24 CITED REFERENCES AVAILABLE FOR THIS RECORD

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L57 ANSWER 27 OF 57 COMPENDEX COPYRIGHT 2006 EEI on STN

AN 2005(30):11273 COMPENDEX

TI Nano-scale modified inorganic/organic hybrid materials as proton conductors.

AU Chou, Berryinne (Case Advanced Power Institute Department of Chemical Engineering Case Western Reserve University, Cleveland, OH 44106, United States); Ghassemi, Hossein; Zawodzinski, Thomas A.

MT 2004 Joint International Meeting - 206th Meeting of the Electrochemical Society/2004 Fall Meeting of the Electrochemical Society of Japan,.

ML Honolulu, HI, United States

MD 03 Oct 2004-08 Oct 2004

SO Meeting Abstracts 2004.p 2023

2004 Joint International Meeting - 206th Meeting of the Electrochemical Society/2004 Fall Meeting of the Electrochemical Society of Japan, MA 2004-02

ISSN: 1091-8213

PY 2004

MN 65239

DT Conference Article

TC Experimental

LA English

AB Proton exchange membranes are a key component in fuel cell systems. Various proton conducting polymers have been used to achieve high proton conductivity, including perfluorosulfonic acids such as Nafion[registered trademark] and Dow membranes as well as a wide range of sulfonated aromatic polymers. For automotive applications, high operation temperature can help fuel cell release the heat and reduce the size of the cooling system. High temperature also increases the anode CO tolerant, and lower humidification is needed. Most polymers studied to date, however, only exhibit acceptable proton conductivity when fully hydrated, limiting the operating temperature to roughly than 80deg C. Therefore, developing new materials for high temperature fuel cells (120-180deg C) operating with

modest humidification is challenging but necessary work. In this work, surface modified silica particles are bound with polymers to form proton-exchange membranes. Polymers such as Poly(vinylidene fluoride) and sulfonated poly(arylene ether sulfone) copolymers are used to bind all the ceramic particles together. Membranes with different amounts and different sizes, 10, 50, and 100  $\mu\text{m}$  of particles have been tested. To introduce acid functionality, different sultone or silane are attached to ceramic particles and converted to sulfonic groups, creating a proton network structure. The silica surface modification is characterized by XPS and membrane's morphology is also studied by using AFM. Proton conductivity is measured at different temperatures and humidity to understand the proton transfer phenomena. In initial studies, sulfonic acid terminated alkyl chains were added to the surface of silica particles. Substantially lower conductivity per mole of acid were observed. In this talk, we will discuss our understanding of the role of several possible limiting factors in determining the conductivity of such composite networks. The roles of the density of proton carriers, the intrinsic proton acidity, inter-particle hopping and the intrinsic proton mobility near the particle will be assessed.

CC 931.3 Atomic and Molecular Physics; 704.1 Electric Components; 933.1 Crystalline Solids; 804.1 Organic Compounds; 443.1 Atmospheric Properties; 482.2 Minerals  
 CT \*Protons; Carboxylic acids; Atmospheric humidity; Nanostructured materials; Atomic force microscopy; Pore size; Silica; Electric conductors  
 ST Proton conductors; Organic hybrid materials; Silica particles; Proton carriers  
 ET C\*O; CO; C cp; cp; O cp

L57 ANSWER 28 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
 AN 2004:938530 HCPLUS  
 DN 142:117499  
 ED Entered STN: 08 Nov 2004  
 TI Preparation of the electrode for high temperature PEFCs using novel polymer electrolytes based on organic/inorganic nanohybrids  
 AU Nishikawa, Osamu; Sugimoto, Toshiya; Nomura, Shigeki; Doyama, Kazuo; Miyatake, Kenji; Uchida, Hiroyuki; Watanabe, Masahiro  
 CS NBO Development Center, Sekisui Chemical Co. Ltd., Tsukuba, 300-4292, Japan  
 SO Electrochimica Acta (2004), 50(2-3), 667-672  
 CODEN: ELCAAV; ISSN: 0013-4686  
 PB Elsevier B.V.  
 DT Journal  
 LA English  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 AB Novel organic/inorg. hybrid electrolytes for high-temperature polymer electrolyte

fuel cells (PEFCs) were synthesized from 1,8-bis(triethoxysilyl)octane (TES-Oct) and 3-(trihydroxysilyl)-1-propanesulfonic acid ((THS)Pro-SO<sub>3</sub>H) via the sol-gel process. The membranes with sulfonic acid groups covalently bonded to the silica showed higher proton conductivity, of  $5 + 10^{-2}$  S/cm at 160°, than that of previously reported homologous materials containing phosphotungstic acid as acid function. A series of electrodes with different composition of the organic/inorg. nanohybrid materials to the platinum loaded carbon were prepared in order to elucidate the availability of the electrolytes in the catalyst layer. By optimizing the composition of the nanohybrids, high electrode performance comparable to that using Nafion ionomer was obtained. The novel organic/inorg. hybrid materials thus have proved to be a promising material as the ionomer in the electrodes and the electrolyte

membranes for high-temperature PEFCs.

ST polymer electrolyte fuel cell hybrid inorg org  
separator; silica org hybrid separator fuel cell;  
proton cond silica org hybrid ionomer fuel cell  
separator

IT Hybrid organic-inorganic materials  
(fuel cell separators; silica-based organic-inorg.  
nanohybrid materials as ionomer separators and electrolytes for PEFCs)

IT Ionomers  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic  
preparation); PREP (Preparation); USES (Uses)  
(fuel cell separators; silica-based organic-inorg.  
nanohybrid materials as ionomer separators and electrolytes for PEFCs)

IT Ionic conductivity  
(proton; silica-based organic-inorg. nanohybrid materials as ionomer  
separators and electrolytes for PEFCs)

IT Fuel cell electrolytes  
Fuel cell separators  
Sol-gel processing  
(silica-based organic-inorg. nanohybrid materials as ionomer separators  
and electrolytes for PEFCs)

IT 7631-86-9DP, Silica, reaction products with bis(triethoxysilyl)octane and  
(trihydroxysilyl)propanesulfonic acid 52217-60-4DP, 1,8-  
Bis(triethoxysilyl)octane, reaction products with (trihydroxysilyl)  
propanesulfonic acid and silica 70942-24-4DP,  
3-(Trihydroxysilyl)-1-propanesulfonic acid, reaction products with  
bis(triethoxysilyl)octane and silica  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic  
preparation); PREP (Preparation); USES (Uses)  
(nanohybrid material, fuel cell separator;  
silica-based organic-inorg. nanohybrid materials as ionomer separators and  
electrolytes for PEFCs)

RE.CNT 51 THERE ARE 51 CITED REFERENCES AVAILABLE FOR THIS RECORD

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L57 ANSWER 29 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN

AN 2004:755069 HCPLUS

DN 142:201347

ED Entered STN: 16 Sep 2004

TI Preparation and characterization of sulfonated poly(phthalazinone ether sulfone ketone) (SPPESK)/silica hybrid membranes for direct methanol fuel cell applications

AU Kim, Dae Sik; Shin, Kwang Ho; Ho, Bum Park; Lee, Young Moo

CS National Research Laboratory for Membranes, School of Chemical Engineering, College of Engineering, Hanyang University, Seoul, 133-791, S. Korea

SO Macromolecular Research (2004), 12(4), 413-421

CODEN: MRAECT; ISSN: 1598-5032

PB Polymer Society of Korea

DT Journal

LA English

CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)

Section cross-reference(s): 38

AB Sulfonated poly(phthalazinone ether sulfone ketone) (SPPESK) membranes and sol-gel derived SPPESK/silica hybrid membranes were investigated as potential polymer electrolyte membranes for direct methanol fuel cell (DMFC) applications. In comparison with the SPPESK membrane, the SPPESK/silica membranes exhibited higher water content, improved proton conductivity, and lower methanol permeability. Notably, the silica embedded in the membrane acted as a material for reducing the fraction of free water and as a barrier for methanol transport through the membrane. From the results of proton conductivity and methanol permeability studies, the authors suggest that the fractions of bound and free water should be optimized to obtain desirable proton conductivities and methanol permeabilities. The highly sulfonated PPESK hybrid membrane (HSP-Si) displayed higher proton conductivity ( $3.42 + 102$  S/cm) and lower methanol permeability ( $4.15 + 107$  cm<sup>2</sup>/s) than those of Nafion 117 ( $2.54 + 102$  S/cm;  $2.36 + 106$  cm<sup>2</sup>/s, resp.) at 30 °C. This characteristic of the SPPESK/silica membranes is desirable for future

applications related to DMFCs.

ST sulfonated polyether polysulfone polyketone methanol fuel cell membrane; polyphthalazinone ether sulfone ketone membrane permeability proton cond

IT Ion exchange membranes  
(IEC value; preparation and characterization of sulfonated poly(phthalazinone ether sulfone ketone) (SPPESK)/silica hybrid membranes for direct methanol fuel cell applications)

IT Polysulfones, uses  
RL: DEV (Device component use); POF (Polymer in formulation); TEM (Technical or engineered material use); USES (Uses)  
(polyether-polyketone-, sulfonated; preparation and characterization of sulfonated poly(phthalazinone ether sulfone ketone) (SPPESK)/silica hybrid membranes for direct methanol fuel cell applications)

IT Polyketones  
RL: DEV (Device component use); POF (Polymer in formulation); TEM (Technical or engineered material use); USES (Uses)  
(polyether-polysulfone-, sulfonated; preparation and characterization of sulfonated poly(phthalazinone ether sulfone ketone) (SPPESK)/silica hybrid membranes for direct methanol fuel cell applications)

IT Polyethers, uses  
RL: DEV (Device component use); POF (Polymer in formulation); TEM (Technical or engineered material use); USES (Uses)  
(polyketone-polysulfone-, sulfonated; preparation and characterization of sulfonated poly(phthalazinone ether sulfone ketone) (SPPESK)/silica hybrid membranes for direct methanol fuel cell applications)

IT Fuel cell separators  
Fuel cells  
Permeability  
Swelling, physical  
(preparation and characterization of sulfonated poly(phthalazinone ether sulfone ketone) (SPPESK)/silica hybrid membranes for direct methanol fuel cell applications)

IT Ionic conductivity  
(proton; preparation and characterization of sulfonated poly(phthalazinone ether sulfone ketone) (SPPESK)/silica hybrid membranes for direct methanol fuel cell applications)

IT 7631-86-9, Silica, uses  
RL: DEV (Device component use); TEM (Technical or engineered material use); USES (Uses)  
(preparation and characterization of sulfonated poly(phthalazinone ether sulfone ketone) (SPPESK)/silica hybrid membranes for direct methanol fuel cell applications)

IT 67-56-1, Methanol, processes 7732-18-5, Water, processes  
RL: PEP (Physical, engineering or chemical process); PYP (Physical process); PROC (Process)  
(preparation and characterization of sulfonated poly(phthalazinone ether sulfone ketone) (SPPESK)/silica hybrid membranes for direct methanol fuel cell applications)

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L57 ANSWER 30 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN  
 AN 2004:913299 HCAPLUS  
 DN 142:159314  
 ED Entered STN: 01 Nov 2004  
 TI Surface-Modified Nanopore Glass Membrane as Electrolyte for DMFCs  
 AU Ioroi, Tsutomu; Kuraoka, Koji; Yasuda, Kazuaki; Yazawa, Tetsuo; Miyazaki, Yoshinori  
 CS National Institute of Advanced Industrial Science and Technology, Research Institute for Ubiquitous Energy Devices, Ikeda, Osaka, 563-8577, Japan  
 SO Electrochemical and Solid-State Letters (2004), 7(11), A394-A396  
 CODEN: ESLEF6; ISSN: 1099-0062  
 PB Electrochemical Society  
 DT Journal  
 LA English  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 AB A porous glass membrane, modified with sulfonic acid groups, was evaluated as a p-conducting electrolyte in direct MeOH fuel cells (DMFCs). Cell performance was characterized by voltage vs. current measurements, EIS, and MeOH permeation measurements. When diluted MeOH, 3M, was supplied to the cell, the porous glass membrane showed inferior performance compared to Nafion due to lower conductivity of the porous glass membrane. However, the porous glass membrane performed better with a 17.5M MeOH solution than the Nafion membrane. The improved performance of the porous glass membrane is due to lower MeOH permeation in concentrated MeOH solns.

ST nanoporous glass membrane surface modified electrolyte DMFC  
 IT Silicate glasses  
 RL: DEV (Device component use); USES (Uses)  
 (mercaptopropyl trimethoxysilane modified, oxidized  
 with sulfonic acid; surface-modified nanoporous glass  
 membrane as electrolyte for DMFCs)  
 IT Porous materials  
 (nanoporous; surface-modified nanoporous glass membrane as electrolyte  
 for DMFCs)  
 IT Fuel cell electrolytes  
 Fuel cells  
 Surface treatment  
 (surface-modified nanoporous glass membrane as electrolyte for DMFCs)  
 IT 4420-74-0, (3-Mercaptopropyl)trimethoxysilane  
 RL: CPS (Chemical process); PEP (Physical, engineering or chemical  
 process); PROC (Process)  
 (glass modified with; surface-modified nanoporous glass membrane as  
 electrolyte for DMFCs)  
 IT 60676-86-0D, Vitreous silica, mercaptopropyl  
 trimethoxysilane modified, oxidized with  
 sulfonic acid  
 RL: DEV (Device component use); USES (Uses)  
 (surface-modified nanoporous glass membrane as electrolyte for DMFCs)

RE.CNT 12 THERE ARE 12 CITED REFERENCES AVAILABLE FOR THIS RECORD

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L57 ANSWER 31 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN

AN 2004:413991 HCPLUS

DN 141:126237

ED Entered STN: 21 May 2004

TI Sulfonated multiblock copoly(ether sulfone)s as membrane materials for  
 fuel cell applications

AU Taeger, Antje; Vogel, Claus; Lehmann, Dieter; Lenk, Wolfgang; Schlenstedt,  
 Kornelia; Meier-Haack, Jochen

CS Institute of Polymer Research Dresden, Dresden, 01005, Germany

SO Macromolecular Symposia (2004), 210(Reactive Polymers 2003), 175-184  
 CODEN: MSYMEC; ISSN: 1022-1360

PB Wiley-VCH Verlag GmbH & Co. KGaA

DT Journal

LA English

CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 35, 38, 76

AB Arylene ether multi-block copolymers of the (AB)<sub>n</sub>-type with various  
 degrees of sulfonation were prepared by a two-step polycondensation  
 procedure. Multi-block copolymers in high yields and of high mol. wts.  
 were obtained. For comparison random copolymers with the same overall  
 composition were synthesized. The theor. ion-exchange capacities (IEC) of the

: materials were ranging from 0.50 mmol/g to 1.25 mmol/g. The water-uptake of the multi-block copolymers showed a linear dependency from the IEC and was increasing with increasing IEC. No differences were observed between random and block copolymers. Also, the hydrolytic stability of aromatic sulfonic acid groups was studied. Aromatic sulfonic acids, having addnl. electron donating groups, especially in ortho- or para-position to the sulfonic acid group are sensitive to hydrolytic desulfonation. However, electron-withdrawing groups in meta-position showed a stabilizing effect.

ST sulfonated multiblock copolymer ether sulfone membrane methanol  
fuel cell; arom polyether polysulfone fuel  
cell separator ion exchange membrane

IT Polymers, preparation  
RL: PRP (Properties); RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)  
(block; sulfonated multiblock copoly(ether sulfone)s as membrane  
materials for fuel cell applications)

IT Cation exchange  
(capacity of various membranes; sulfonated multiblock copoly(ether sulfone)s as membrane materials for fuel cell  
applications)

IT Polymerization  
(condensation; sulfonated multiblock copoly(ether sulfone)s as membrane  
materials for fuel cell applications)

IT Ionic conductivity  
(of membranes; sulfonated multiblock copoly(ether sulfone)s as membrane  
materials for fuel cell applications)

IT Polysulfones, preparation  
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
(polyether-, aromatic, block, sulfonated; sulfonated multiblock  
copoly(ether sulfone)s as membrane materials for fuel  
cell applications)

IT Polysulfones, preparation  
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
(polyether-, aromatic; sulfonated multiblock copoly(ether sulfone)s as  
membrane materials for fuel cell applications)

IT Polyethers, preparation  
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
(polysulfone-, aromatic, block, sulfonated; sulfonated multiblock  
copoly(ether sulfone)s as membrane materials for fuel  
cell applications)

IT Polyethers, preparation  
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
(polysulfone-, aromatic; sulfonated multiblock copoly(ether sulfone)s as  
membrane materials for fuel cell applications)

IT Fuel cells  
(proton exchange membrane; sulfonated multiblock copoly(ether sulfone)s  
as membrane materials for fuel cell applications)

IT Sulfonation  
(retrosulfonation; sulfonated multiblock copoly(ether sulfone)s as  
membrane materials for fuel cell applications)

IT Fuel cell separators

Ion exchange membranes

Silylation  
(sulfonated multiblock copoly(ether sulfone)s as membrane materials for  
fuel cell applications)

IT 7732-18-5, Water, processes  
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP  
(Physical process); PROC (Process)  
(absorption; sulfonated multiblock copoly(ether sulfone)s as membrane  
materials for fuel cell applications)

IT 7664-93-9, Sulfuric acid, analysis  
 RL: ANT (Analyte); FMU (Formation, unclassified); ANST (Analytical study); FORM (Formation, nonpreparative)  
 (from desulfonation reaction; sulfonated multiblock copoly(ether sulfone)s as membrane materials for fuel cell applications)

IT 1094-10-6P, 2,2'-Biphenol bis(trimethylsilyl) ether  
 RL: ANT (Analyte); PRP (Properties); SPN (Synthetic preparation); ANST (Analytical study); PREP (Preparation)  
 (sulfonated multiblock copoly(ether sulfone)s as membrane materials for fuel cell applications)

IT 584-08-7, Potassium carbonate (K<sub>2</sub>CO<sub>3</sub>)  
 RL: CAT (Catalyst use); RCT (Reactant); RACT (Reactant or reagent); USES (Uses)  
 (sulfonated multiblock copoly(ether sulfone)s as membrane materials for fuel cell applications)

IT 7664-41-7, Ammonia, formation (nonpreparative)  
 RL: FMU (Formation, unclassified); FORM (Formation, nonpreparative)  
 (sulfonated multiblock copoly(ether sulfone)s as membrane materials for fuel cell applications)

IT 7647-14-5, Sodium chloride, processes 12125-02-9, Ammonium chloride, processes  
 RL: FMU (Formation, unclassified); PEP (Physical, engineering or chemical process); PYP (Physical process); REM (Removal or disposal); FORM (Formation, nonpreparative); PROC (Process)  
 (sulfonated multiblock copoly(ether sulfone)s as membrane materials for fuel cell applications)

IT 67-56-1, Methanol, properties 12408-02-5, Hydrogen, ion(1+), properties  
 66796-30-3, Nafion 117  
 RL: PRP (Properties)  
 (sulfonated multiblock copoly(ether sulfone)s as membrane materials for fuel cell applications)

IT 133717-07-4P 722454-90-2P 722454-91-3P 722499-69-6DP, hydrolyzed  
 RL: PRP (Properties); RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)  
 (sulfonated multiblock copoly(ether sulfone)s as membrane materials for fuel cell applications)

IT 722454-92-4P 722454-93-5P  
 RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
 (sulfonated multiblock copoly(ether sulfone)s as membrane materials for fuel cell applications)

IT 75-77-4, Chlorotrimethylsilane, reactions 92-88-6,  
 4,4'-Dihydroxybiphenyl 999-97-3, Hexamethyldisilazane 7647-01-0,  
 Hydrochloric acid, reactions 10021-55-3  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (sulfonated multiblock copoly(ether sulfone)s as membrane materials for fuel cell applications)

IT 722454-89-9P  
 RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
 (tris-TMS-HQSA; sulfonated multiblock copoly(ether sulfone)s as membrane materials for fuel cell applications)

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L57 ANSWER 32 OF 57 INSPEC (C) 2006 IET on STN  
AN 2005:8314934 INSPEC DN A2005-08-8120T-014; B2005-04-8410G-014  
TI Hybrid proton-carrier polymer composites for high-temperature FCPEM applications  
AU Pern, F.J.; Turner, J.A.; (Nat. Renewable Energy Lab., Golden, CO, USA), Herring, A.M.  
SO Nanostructured Materials in Alternative Energy Devices (Materials Research Society Symposium Proceedings Vol.822), 2004, p. 159-64 of ix+174 pp., 10 refs.  
Editor(s): Kelder, E.M.; Leite, E.R.; Tarascon, J.-M.; Chiang, Y.-M.  
Published by: Materials Research Society, Warrendale, PA, USA  
Conference: Nanostructured Materials in Alternative Energy Devices, San Francisco, CA, USA, 13-15 April 2004  
DT Conference; Conference Article  
TC Practical; Experimental  
CY United States  
LA English  
AB Hybrid proton-carrier polymer composites were fabricated in an effort to develop high-performance high-temperature proton exchange membranes (PEMs) for fuel cell applications in the 100°-200°C range. The solution-cast hybrid membranes comprise a polymer host and a SiO<sub>2</sub>-based proton-carrier composite that was synthesized via sol gel approach using a functional silane and tetraethoxysilane (TEOS) in acidic conditions. The primary H<sup>+</sup>-carrying component was either a heteropoly silicotungstic acid (STA) or a sulfonic acid (SFA) that was thermo-oxidatively converted from a mercapto (-SH) group. The embedding level of STA on the silane-modified SiO<sub>2</sub> sol gel composites was strongly affected by the presence and the functional group of the silane. Ion exchange capacity (IEC) of the water-washed, SiO<sub>2</sub>-based STA and SFA proton-carrier composite powders is in the range of 1.8-3.5 mmol/g, two to three times higher than that for Nafion 117 (0.9 meq/mol). A glycidylmethacrylate-type copolymer, PEMAGMA, which is stable up to 225°C, was able to produce mechanically robust and flexible hybrid membranes. Upon curing, the PEMAGMA composite membranes showed a 75% gel under the present formulation and retained the 'free' STA effectively with slight loss when extracted in an

85°C water. The W12-STA-containing PEMAGMA membranes followed the weight loss trends of water from STA and the SiO<sub>2</sub> based sol gel composite, showing a 10 wt% loss at 150°C and a 15 wt% loss at 225°C. Fuel cell performance tests of the preliminary films gave a Voc in the 0.85-0.93 V range, but a low current density of <4 mA/cm<sup>2</sup>. The resistive characteristics were attributed to inhomogeneous distribution of the sol gel nanoparticles in the PEMAGMA matrix, a result of phase separation and particulate agglomeration during film forming

CC A8120T Preparation of reinforced polymers and polymer-based composites; A8630G Fuel cells; A6475 Solubility, segregation, and mixing; A8230H Chemical exchanges (substitution, atom transfer, abstraction, disproportionation, and group exchange); A8265F Film and membrane processes; ion exchange; dialysis; osmosis, electro-osmosis; B8410G Fuel cells; B0560 Polymers and plastics (engineering materials science); B0550 Composite materials (engineering materials science)

CT current density; filled polymers; ion exchange; nanoparticles; organic-inorganic hybrid materials; phase separation; polymer blends; proton exchange membrane fuel cells; sol-gel processing

ST hybrid proton carrier polymer composites powder; fuel cell application; hybrid membranes; sol gel method; silane; tetraethoxysilane; acidic conditions; heteropoly silicotungstic acid; sulfonic acid; mercapto group; ion exchange capacity; glycidylmethacrylate type copolymer; pemagma matrix; current density; inhomogeneous distribution; phase separation; agglomeration; high-temperature proton exchange membranes; polymer; sol gel nanoparticles; film formation; water wash; PEMAGMA; 100 to 200 degC; 85 degC; 225 degC; 0.85 to 0.93 V; SiO<sub>2</sub>

CHI SiO<sub>2</sub> int, O<sub>2</sub> int, Si int, O int, SiO<sub>2</sub> bin, O<sub>2</sub> bin, Si bin, O bin

PHP temperature 3.73E+02 to 4.73E+02 K; temperature 3.58E+02 K; temperature 4.98E+02 K; voltage 8.5E-01 to 9.3E-01 V

ET O; Si; O\*Si; SiO; Si cp; cp; O cp; C; SiO<sub>2</sub>; H; H+; H ip 1; ip 1; W

L57 ANSWER 33 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
AN 2004:839091 HCPLUS

DN 142:25774

ED Entered STN: 14 Oct 2004

TI Modifying Nafion with nanostructured inorganic oxides for proton exchange membrane fuel cells

AU Daiko, Yusuke; Klein, Lisa C.; Nogami, Masayuki

CS Ceramic and Materials Engineering Rutgers, The State University of New Jersey, Piscataway, NJ, 08854-8065, USA

SO Materials Research Society Symposium Proceedings (2004), 822(Nanostructured Materials in Alternative Energy Devices), 153-158  
CODEN: MRSPDH; ISSN: 0272-9172

PB Materials Research Society

DT Journal

LA English

CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
Section cross-reference(s): 38, 76

AB Nafion, a perfluorosulfonate ionomer, was modified to increase its thermal stability and reduce its methanol permeability. Hybrid membranes of TiO<sub>2</sub>·SiO<sub>2</sub>/Nafion and TiO<sub>2</sub>·SiO<sub>2</sub>·P2O<sub>5</sub>/Nafion were prepared using an infiltration sol-gel method. Si(OEt)<sub>4</sub> and Ti(OBu)<sub>4</sub> were infiltrated into dry Nafion membranes, followed by hydrolysis and condensation reactions in 1st HCl and then NH<sub>4</sub>OH solns. The level of inorg. content was controlled by the infiltration time, incorporating up to 50%. Solvent uptake, swelling, water content and proton conductivity were measured at room temperature. Hybrid membranes of TiO<sub>2</sub>·SiO<sub>2</sub>/Nafion with

.apprx.30 % of infiltrated oxides showed a significantly lower methanol uptake of .apprx.20 % and a swelling ratio of 1.15, as compared to those of unmodified Nafion membrane, .apprx.60 % for methanol uptake and 1.8 for swelling ratio. Proton conductivities for TiO<sub>2</sub>·SiO<sub>2</sub>/Nafion hybrid membranes decreased with increasing infiltrated oxides. However, infiltrated membranes treated in phosphoric acid solns. to increase the number of P-OH groups showed a 6-fold increase in proton conductivity

ST Nafion nanostructure network silicon titanium oxide proton exchange membrane; proton exchange membrane fuel cell cond methanol solvent swelling

IT Polyoxyalkylenes, uses

RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)

(fluorine- and sulfo-containing, ionomers, plain and network composite with Silica/titania network; modifying Nafion with nanostructured inorg. oxides for proton exchange membrane fuel cells)

IT Fluoropolymers, uses

RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)

(ionomers, sulfo-containing, network composites with silica/titaniaa and optionally phosphoric acid; modifying Nafion with nanostructured inorg. oxides for proton exchange membrane fuel cells)

IT Nanostructures

Swelling, physical

(modifying Nafion with nanostructured inorg. oxides for proton exchange membrane fuel cells)

IT Membranes, nonbiological

(permselective, composite, hybrid; modifying Nafion with nanostructured inorg. oxides for proton exchange membrane fuel cells)

IT Fluoropolymers, uses

RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)

(polyoxyalkylene-, sulfo-containing, ionomers, plain and network composite with Silica/titania network; modifying Nafion with nanostructured inorg. oxides for proton exchange membrane fuel cells)

IT Fuel cells

(proton exchange membrane; modifying Nafion with nanostructured inorg. oxides for proton exchange membrane fuel cells)

IT Ionic conductivity

(proton; modifying Nafion with nanostructured inorg. oxides for proton exchange membrane fuel cells)

IT 67-56-1, Methanol, processes

RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); PROC (Process)

(absorption and permeation of; modifying Nafion with nanostructured inorg. oxides for proton exchange membrane fuel cells)

IT 7732-18-5, Water, processes

RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); PROC (Process)

(absorption; modifying Nafion with nanostructured inorg. oxides for proton exchange membrane fuel cells)

IT 7664-38-2, Phosphoric acid, reactions

RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)

(composite with Nafion/silica-titania network;  
modifying Nafion with nanostructured inorg. oxides  
for proton exchange membrane fuel cells)

IT 13772-30-0, Titanium hydrogen phosphate ( $Ti(HPO_4)_2$ )

RL: FMU (Formation, unclassified); PRP (Properties); FORM (Formation, nonpreparative)

(formed; modifying Nafion with nanostructured inorg. oxides  
for proton exchange membrane fuel cells)

IT 7647-01-0, Hydrochloric acid, reactions

RL: PEP (Physical, engineering or chemical process); PYP (Physical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)

(modifying Nafion with nanostructured inorg. oxides for  
proton exchange membrane fuel cells)

IT 1336-21-6, Ammonium hydroxide ((NH<sub>4</sub>)(OH))

RL: RCT (Reactant); RACT (Reactant or reagent)

(modifying Nafion with nanostructured inorg. oxides for  
proton exchange membrane fuel cells)

IT 69013-31-6P

RL: PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)

(network composite with Nafion and optionally phosphoric acid; modifying Nafion with nanostructured inorg. oxides for proton exchange membrane fuel cells)

RE.CNT 20 THERE ARE 20 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

- (1) Adjemian, K; J Power Sources 2002, V109, P356 HCPLUS
- (2) Anderson, M; Nano lett 2002, V2, P235 HCPLUS
- (3) Aparicio, M; Ceramic Transactions 2002, V127, P167 HCPLUS
- (4) Buchi, F; Electrochim Acta 1995, V40, P345 HCPLUS
- (5) Daiko, Y; Chem Mater 2002, V11, P4624
- (6) Daiko, Y; J Ceram Soc Jpn 2001, V109, P815 HCPLUS
- (7) Damay, F; Solid State Ionics 2003, V162-163, P261 HCPLUS
- (8) Elabd, Y; J Memb Sci 2003, V217, P227 HCPLUS
- (9) Jones, J; J Memb Sci 2001, V185, P41
- (10) Kerres, J; J Memb Sci 2001, V185, P3 HCPLUS
- (11) Li, Q; Chem Mater 2003, V15, P4896 HCPLUS
- (12) Miyake, N; J Electrochem Soc 2001, V148, PA905 HCPLUS
- (13) Nogami, M; Adv Mater 2000, V12, P1370 HCPLUS
- (14) Nogami, M; J Phys Chem 1999, V103, P9468 HCPLUS
- (15) Nogami, M; Phys Rev B 1997, V55, P12108 HCPLUS
- (16) Nogami, M; Solid State Ionics, article in press 2003
- (17) Ren, X; J Electrochem Soc 2000, V147, P92 HCPLUS
- (18) Shao, P; J Polym Sci B, Poly Phys 1996, V34, P873 HCPLUS
- (19) Wasmus, S; J Electroanal Chem 1999, V461, P14 HCPLUS
- (20) Yamaguchi, T; Adv Mater 2003, V15, P1198 HCPLUS

L57 ANSWER 34 OF 57 JICST-EPlus COPYRIGHT 2006 JST on STN

AN 1050126208 JICST-EPlus

TI Preparation and Characterization of Self-Standing Composite Electrolyte Membrane Composed of Silica Matrix and Poly (ether ether sulfone)

AU MUNAKATA HIROKAZU; SASAJIMA KEIJI; DOKKO KAORU; HAMAGAMI JUN'ICHI; TAKEI TAKASHI; KANAMURA KIYOSHI

CS Toritsudai In

SO Kotai Ionikusu Toronkai Koen Yoshishu (Extended Abstracts. Symposium on Solid State Ionics in Japan), (2004) vol. 30th, pp. 50-51. Journal Code: L1398A (Fig. 2, Ref. 3)

CY Japan  
DT Conference; Short Communication  
LA Japanese  
STA New  
AB Composite membrane composed of three-dimensionally ordered macroporous silica and proton conductive polymer electrolyte was fabricated for fuel cells. In this study, sulfonated poly (ether ether sulfone) (S-PEES) was synthesized and examined as a new proton conductive polymer. The composite membrane exhibited an excellent proton conductivity of  $4.8 \times 10^{-1}$  S cm<sup>-1</sup> at 60 .DEG.C. under 90% relative humidity. This value was about three times higher than that of Nafion 117 membrane.  
(author abst.)  
CC BK14060A; BM03045F; YB04040V (539.23:546; 537.311:547; 621.352.6)  
CT silica; polyether; sulfonation; organic-inorganic polymer hybrid; solid electrolyte; preparation(material); ionic conduction; liquid fuel cell; proton  
BT silicon dioxide; silicon oxide; silicon compound; carbon group element compound; oxide; chalcogenide; oxygen group element compound; oxygen compound; polymer; chemical reaction; polymer complex; macromolecule; complex(substance); electrolyte; matter; electric conduction; electrical property; fuel cell; chemical cell; battery; nucleon; baryon; hadron; elementary particle  
ST proton conduction

L57 ANSWER 35 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN DUPLICATE 4  
AN 2004:335152 HCPLUS  
DN 141:192927  
ED Entered STN: 25 Apr 2004  
TI Modification and characterization of methanol-resistant membranes  
AU Song, Hong-feng; Fang, Jun; Lu, Guo-jing; Shen, Pei-kang  
CS Science College, South China University of Technology, Guangzhou, Guangdong, 510640, Peop. Rep. China  
SO Dianchi (2004), 34(1), 25-26  
CODEN: DNCHEP; ISSN: 1001-1579  
PB Dianchi Zazhishe  
DT Journal  
LA Chinese  
CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
Section cross-reference(s): 72  
AB Cyclic voltammetry was used to determine MeOH permeability of p exchange membranes. Various Nafion membranes were measured and the method can be used to conveniently analyze the MeOH permeability of membranes. Nafion membranes were modified by nanometer SiO<sub>2</sub> sol and the MeOH resistance increased.  
ST Nafion membrane silica methanol permeability fuel cell  
IT Fuel cell separators  
(silica modification and characterization of methanol-resistant membranes for fuel cells)  
IT 7631-86-9, Silica, uses  
RL: MOA (Modifier or additive use); USES (Uses)  
(silica modification and characterization of methanol-resistant membranes for fuel cells)  
IT 66796-30-3, Nafion 117 163294-14-2, Nafion 112  
264217-10-9, Nafion 1135  
RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
(silica modification and characterization of methanol-resistant membranes for fuel cells)

L57 ANSWER 36 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN  
 AN 2003:471766 HCAPLUS  
 ED Entered STN: 20 Jun 2003  
 TI Self humidifying polymer membranes for high temperature PEMFC operation  
 AU Krishnan, Lakshmi; Mann, Jonathan R.; Bocarsly, Andrew B.; Srinivasan, Supramanian  
 CS Department of Chemistry, Princeton University, Princeton, NJ, USA  
 SO Abstracts, 36th Middle Atlantic Regional Meeting of the American Chemical Society, Princeton, NJ, United States, June 8-11 (2003), 48 Publisher: American Chemical Society, Washington, D. C.  
 CODEN: 69EBDT  
 DT Conference; Meeting Abstract  
 LA English  
 AB Proton Exchange Membrane Fuel Cells are suitable for stationary, transportation and portable applications due to their higher efficiencies, low or zero emissions and noise-free operation compared to conventional power sources. The proton conducting membrane needs to be fully hydrated to attain maximum proton conductivity and thus, limits the PEMFC operation to temps. below .apprx.90 °C. However, high temperature (> 120 °C) operation of PEM fuel cells would provide the following advantages: (1) enhanced CO tolerance needed when reformed fuels are utilized, (2) faster electrode kinetics particularly at the oxygen electrode, (3) simpler water management and (4) generation of high-quality waste heat. Several attempts have been made to overcome the membrane dehydration problems associated with high operating temps.; one approach being the implementation of composite Nafion/metal oxide pioneered in our labs. While such cells perform well at 100% relative humidity, loss of water from the membranes under reduced humidity conditions continues to limit the efficiency of such cells. One solution to this problem is the development of thin polymer membranes modified with inorg. additives. Using thin membranes reduce the ohmic losses and also help water retention of the membrane by allowing back diffusion of the product water formed at the cathode. Fuel cell performance of thin membranes modified with titania and silica nanoparticles is reported in this work. Addition of the metal oxide phase is found to improve the water flux across the membrane and to some extent enhance cell self-humidification leading to improved cell output parameters.

L57 ANSWER 37 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN  
 AN 2002:888782 HCAPLUS  
 DN 137:371122  
 ED Entered STN: 22 Nov 2002  
 TI Fluorosulfonic acid polymers for lithium batteries and direct methanol fuel cells and their manufacture  
 IN Yang, Zhen-Yu  
 PA E. I. Du Pont de Nemours & Co., USA  
 SO PCT Int. Appl., 21 pp.  
 CODEN: PIXXD2  
 DT Patent  
 LA English  
 IC ICM C08F008-42  
 ICS C08K005-5419; C08J005-22  
 CC 38-3 (Plastics Fabrication and Uses)  
 Section cross-reference(s): 52  
 FAN.CNT 1  

| PATENT NO.   | KIND  | DATE     | APPLICATION NO. | DATE     |
|--|-------|----------|-----------------|----------|
| -----  | ----- | -----    | -----           | -----    |
| PI WO 2002092646   | A1    | 20021121 | WO 2001-US15604 | 20010514 |
| W: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, |       |          |                 |          |

CO, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM,  
 HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS,  
 LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO,  
 RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ,  
 VN, YU, ZA, ZW, AM, AZ, BY, KG, KZ, MD, RU, TJ, TM  
 RW: GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW, AT, BE, CH, CY,  
 DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR, BF,  
 BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG

|            |    |          |                 |          |
|------------|----|----------|-----------------|----------|
| CA 2441795 | AA | 20021121 | CA 2001-2441795 | 20010514 |
| EP 1397398 | A1 | 20040317 | EP 2001-935501  | 20010514 |
| EP 1397398 | B1 | 20050914 |                 |          |

R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT,  
 IE, SI, LT, LV, FI, RO, MK, CY, AL, TR

|               |    |          |                |          |
|---------------|----|----------|----------------|----------|
| JP 2004529244 | T2 | 20040924 | JP 2002-589525 | 20010514 |
| US 2004266924 | A1 | 20041230 | US 2004-477341 | 20040729 |

PRAI WO 2001-US15604 W 20010514

#### CLASS

| PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES |
|------------|-------|------------------------------------|
|------------|-------|------------------------------------|

|               |       |   |
|---------------|-------|---|
| WO 2002092646 | ICM   | C08F008-42  |
|               | ICS   | C08K005-5419; C08J005-22  |
|               | IPCI  | C08F0008-42 [ICM,7]; C08F0008-00 [ICM,7,C*];<br>C08K0005-5419 [ICS,7]; C08K0005-00 [ICS,7,C*];<br>C08J0005-22 [ICS,7]; C08J0005-20 [ICS,7,C*] |
|               | IPCR  | C08F0008-00 [I,C*]; C08F0008-42 [I,A]; C08J0005-20<br>[I,C*]; C08J0005-22 [I,A]; C08L0101-00 [I,C*];<br>C08L0101-04 [I,A]                     |
| CA 2441795    | ECLA  | C08F008/42+14/18; C08J005/22B2F; C08L101/04+B4S   |
|               | IPCI  | C08F0008-42 [ICM,7]; C08F0008-00 [ICM,7,C*];<br>C08J0005-22 [ICS,7]; C08J0005-20 [ICS,7,C*];<br>C08K0005-5419 [ICS,7]; C08K0005-00 [ICS,7,C*] |
| EP 1397398    | IPCI  | C08F0008-42 [ICM,7]; C08F0008-00 [ICM,7,C*];<br>C08K0005-5419 [ICS,7]; C08K0005-00 [ICS,7,C*];<br>C08J0005-22 [ICS,7]; C08J0005-20 [ICS,7,C*] |
|               | IPCR  | C08F0008-00 [I,C*]; C08F0008-42 [I,A]; C08J0005-20<br>[I,C*]; C08J0005-22 [I,A]; C08L0101-00 [I,C*];<br>C08L0101-04 [I,A]                     |
| JP 2004529244 | ECLA  | C08F008/42+14/18; C08J005/22B2F; C08L101/04+B4S   |
|               | IPCI  | C08L0071-02 [ICM,7]; C08L0071-00 [ICM,7,C*];<br>C08L0083-12 [ICS,7]; C08L0083-00 [ICS,7,C*]   |
|               | IPCR  | C08F0008-00 [I,C*]; C08F0008-42 [I,A]; C08J0005-20<br>[I,C*]; C08J0005-22 [I,A]; C08L0101-00 [I,C*];<br>C08L0101-04 [I,A]                     |
| US 2004266924 | FTERM | 4J002/CH051; 4J002/CP182; 4J002/GQ00  |
|               | IPCI  | C08L0001-00 [ICM,7]   |
|               | IPCR  | C08L0001-00 [I,A]; C08L0001-00 [I,C*]   |
|               | NCL   | 524/262.000   |

AB The composition comprises a polymer having a fluorinated backbone and 3-20 mol% pendant groups -Op[CF(Rf1)CFOM]nCF2CF2SO3X (Rf = F, Cl-10 perfluoroalkyl (un)substituted by ≥1 ether oxygen atom; m = 0, 1; n = 0-3; p = 0, 1; X = H, alkali metal) and 0.5-40% siloxane comprising ≥2 groups -OaSi(OH)b-aR13-bR2Rf2SO3X (a = 1-b; b = 1-3; R1 = nonhydrolyzable group selected from alkyl, cycloalkyl, aryl and aralkyl; X = alkali metal, H; R2 = alkylene (un)substituted by ≥1 ether oxygen atom; and Rf2 = perfluoroalkylene ether (un)substituted by ≥1 ether oxygen atom). The shape articles formed from the composition having high ionic conductivity

and

improved barrier to methanol permeation are useful in lithium batteries and direct methanol fuel cells. Thus, methanol-treated 0.235 g Nation 151 films was immersed in 4.0 g

(CH<sub>30</sub>)<sub>3</sub>SiCH<sub>2</sub>CH<sub>2</sub>CF<sub>2</sub>CF<sub>2</sub>OCF<sub>2</sub>CF<sub>2</sub>SO<sub>2</sub>F [prepared from ICF<sub>2</sub>CF<sub>2</sub>OCF<sub>2</sub>CF<sub>2</sub>SO<sub>2</sub>F and (CH<sub>30</sub>)<sub>3</sub>SiCH:CH<sub>2</sub>] at 60° for 30 min., applied over the surface with 3 drops CF<sub>3</sub>CO<sub>2</sub>H to give a film showing Conductivity 0.055 S/cm.

ST fluorosulfonic acid polymer film lithium battery; methanol fuel cell siloxane fluorosulfonic acid polymer; ionic cond siloxane fluorosulfonic acid polymer

IT Primary batteries  
(lithium; preparation of alkoxy silane-modified fluorosulfonic acid polymers for lithium batteries and direct methanol fuel cells)

IT Sulfonic acids, uses  
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(perfluorosulfonic acid polymers; preparation of alkoxy silane-modified fluorosulfonic acid polymers for lithium batteries and direct methanol fuel cells )

IT Fuel cells  
(preparation of alkoxy silane-modified fluorosulfonic acid polymers for lithium batteries and direct methanol fuel cells)

IT Ionomers  
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(preparation of alkoxy silane-modified fluorosulfonic acid polymers for lithium batteries and direct methanol fuel cells)

IT Fluoropolymers, uses  
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(sulfo-containing, perfluoro; preparation of alkoxy silane-modified fluorosulfonic acid polymers for lithium batteries and direct methanol fuel cells)

IT 66796-30-3DP, Nafion 117, reaction products with fluorinated ethanesulfonyl silane 162774-80-3DP, Nafion 105, reaction products with fluorinated ethanesulfonyl silane 264918-44-7DP, Nafion 151, reaction products with fluorinated ethanesulfonyl silane  
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(film; preparation of alkoxy silane-modified fluorosulfonic acid polymers for lithium batteries and direct methanol fuel cells)

IT 84271-41-0DP, reaction products with fluorosulfonic acid polymers 194343-81-2DP, reaction products with fluorosulfonic acid polymers  
RL: IMF (Industrial manufacture); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(preparation of alkoxy silane-modified fluorosulfonic acid polymers for lithium batteries and direct methanol fuel cells)

IT 2768-02-7 66137-74-4  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(starting material; preparation of alkoxy silane-modified fluorosulfonic acid polymers for lithium batteries and direct methanol fuel cells)

RE.CNT 7 THERE ARE 7 CITED REFERENCES AVAILABLE FOR THIS RECORD  
RE  
(1) Ausimont S P A; EP 0879851 A 1998 HCPLUS  
(2) Beckerbauer, R; US 5958822 A 1999 HCPLUS

- (3) Connolly, D; US 3282875 A 1966
- (4) Doyle, C; US 6140436 A 2000 HCPLUS
- (5) Hiyoshi, T; US 4904701 A 1990 HCPLUS
- (6) Kanegafuchi Chem Kk; JP 54005889 A 1979 HCPLUS
- (7) Osawa, Y; US 5371150 A 1994 HCPLUS

L57 ANSWER 38 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
AN 2002:602740 HCPLUS  
DN 138:58765  
ED Entered STN: 13 Aug 2002  
TI Developing high-temperature, CO tolerant polymer electrolyte membrane fuel cells  
AU Tulyani, S.; Adjemian, K. T.; Krishnan, L.; Yang, C.; Srinivasan, S.; Bocarsly, A. B.; Benziger, J. B.  
CS Department of Chemical Engineering, Princeton University, Princeton, NJ, 08544, USA  
SO Preprints of Symposia - American Chemical Society, Division of Fuel Chemistry (2002), 47(2), 675-676  
CODEN: PSADFZ; ISSN: 1521-4648  
PB American Chemical Society, Division of Fuel Chemistry  
DT Journal  
LA English  
CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
Section cross-reference(s): 38  
AB Elevated operating temps. improve fuel cell reaction impurities, but polymer electrolyte membranes for use with CO impurities cause difficulties in maintaining the hydration levels necessary for proton ion conductivity. Membranes were modified by impregnation of tetraethoxysilane, which creates mesoscopic silicon oxide particles. Also, Nafion 115 solution was mixed with a polysiloxane solution to cast a modified membrane. A silica sol from tetraethoxysilane was added to a Nafion 115 solution and brushed onto the electrodes, increasing moisture and conductivity levels. Addition of metal zirconium phosphate to the Nafion membrane did not improve water absorption.  
ST high temp polymer electrolyte membrane fuel cell  
silica modification  
IT Electric conductivity  
Electric current-potential relationship  
Fuel cells  
Polymer electrolytes  
(developing high-temperature, CO tolerant polymer electrolyte membrane fuel cells)  
IT Polysiloxanes, uses  
RL: DEV (Device component use); MOA (Modifier or additive use); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
(developing high-temperature, CO tolerant polymer electrolyte membrane fuel cells)  
IT Imbibition  
(of water; developing high-temperature, CO tolerant polymer electrolyte membrane fuel cells)  
IT 78-10-4, Tetraethoxysilane 7631-86-9, Silica, uses 13765-95-2D, Zirconium phosphate, composite with Nafion 115  
RL: DEV (Device component use); MOA (Modifier or additive use); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
(developing high-temperature, CO tolerant polymer electrolyte membrane fuel cells)  
IT 77950-55-1D, Nafion 115, plain, and composites with silicon oxide or composites with Zirconium phosphate 176366-09-9D, Aciplex S 1004, composite with silica

RL: DEV (Device component use); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
 (developing high-temperature, CO tolerant polymer electrolyte membrane fuel cells)

RE.CNT 3 THERE ARE 3 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

- (1) Mikaye, N; J Electrochem Soc 2001, V148(8), PA898
- (2) Register, R; J Polym Sci, Part B: Polym Phys 1992, V30(6), P569 HCPLUS
- (3) Yang, C; J Power Sources 2001, V103, P1 HCPLUS

IT 77950-55-1D, Nafion 115, plain, and composites with silicon oxide or composites with Zirconium phosphate

RL: DEV (Device component use); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
 (developing high-temperature, CO tolerant polymer electrolyte membrane fuel cells)

RN 77950-55-1 HCPLUS

CN Nafion 115 (9CI) (CA INDEX NAME)

\*\*\* STRUCTURE DIAGRAM IS NOT AVAILABLE \*\*\*

L57 ANSWER 39 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN

AN 2001:36918 HCPLUS

DN 134:101944

ED Entered STN: 16 Jan 2001

TI Polyelectrolyte complex membranes

IN Tsusaka, Kyoko; Morimoto, Tomo; Kawakado, Masaya

PA Toyota Central Research and Development Laboratories, Inc., Japan

SO Jpn. Kokai Tokkyo Koho, 9 pp.

CODEN: JKXXAF

DT Patent

LA Japanese

IC ICM C08J007-12

ICS B01D071-70; G01N027-28; H01B001-04; H01B001-06; H01M008-02;  
 C08J005-22

CC 38-3 (Plastics Fabrication and Uses)

Section cross-reference(s): 76

FAN.CNT 1

|      | PATENT NO.     | KIND | DATE     | APPLICATION NO. | DATE     |
|------|----------------|------|----------|-----------------|----------|
| PI   | JP 2001011219  | A2   | 20010116 | JP 1999-181691  | 19990628 |
| PRAI | JP 1999-181691 |      | 19990628 |                 |          |

CLASS

|    | PATENT NO. | CLASS | PATENT FAMILY CLASSIFICATION CODES   |
|----|------------|-------|--|
| JP | 2001011219 | ICM   | C08J007-12   |
|    |            | ICS   | B01D071-70; G01N027-28; H01B001-04; H01B001-06;<br>H01M008-02; C08J005-22  |
|    |            | IPCI  | C08J0007-12 [ICM,7]; B01D0071-70 [ICS,7]; G01N0027-28<br>[ICS,7]; H01B0001-04 [ICS,7]; H01B0001-06 [ICS,7];<br>H01M0008-02 [ICS,7]; C08J0005-22 [ICS,7]  |
|    |            | IPCR  | B01D0071-00 [I,C*]; B01D0071-70 [I,A]; C08J0005-20<br>[N,C*]; C08J0005-22 [N,A]; C08J0007-00 [I,C*];<br>C08J0007-12 [I,A]; G01N0027-28 [I,A]; G01N0027-28<br>[I,C*]; H01B0001-04 [I,A]; H01B0001-04 [I,C*];<br>H01B0001-06 [I,A]; H01B0001-06 [I,C*]; H01M0008-02<br>[I,A]; H01M0008-02 [I,C*] |

AB The title membranes, useful for fuel battery, water, hydrohalogen acid, or NaCl electrolysis, moisture or gas sensor, etc., are prepared by introducing metallocane polymers (e.g., hydrolysis products from phenyltriethoxysilane, or its mixture with tetraethoxysilane;

diethoxydiphenylsilane) into solid polyelectrolytes (e.g., Nafion N 112), and sulfonating (e.g., with fumed H<sub>2</sub>SO<sub>4</sub>).  
ST perfluorocarbon sulfonate polyelectrolyte complex membrane; siloxane perfluorocarbon sulfonate complex membrane  
IT Fluoropolymers, uses  
RL: POF (Polymer in formulation); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
(membranes; polyelectrolyte complex membranes)  
IT Polyelectrolytes  
Sulfonation  
(polyelectrolyte complex membranes)  
IT Membranes, nonbiological  
(semipermeable; polyelectrolyte complex membranes)  
IT 7664-93-9, Sulfuric acid, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(fumed, sulfonation agents; polyelectrolyte complex membranes)  
IT 78-10-4, Tetraethoxysilane 780-69-8, Phenyltriethoxysilane 2553-19-7,  
Diethoxydiphenylsilane  
RL: POF (Polymer in formulation); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
(hydrolysis products from; polyelectrolyte complex membranes)  
IT 303224-97-7, Nafion N 112  
RL: POF (Polymer in formulation); PRP (Properties); TEM (Technical or engineered material use); USES (Uses)  
(polyelectrolyte complex membranes)

L57 ANSWER 40 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN DUPLICATE 5  
AN 2001:808560 HCPLUS  
DN 136:250178  
ED Entered STN: 07 Nov 2001  
TI A performance evaluation of direct methanol fuel cell using impregnated tetraethyl orthosilicate in crosslinked polymer membrane  
AU Jung, Doo Hwan; Myoung, Young-Bun; Cho, Sung-Young; Shin, Dong Ryul; Peck, Dong Hyun  
CS Fuel Cell Research Centre, Korea Institute of Energy Research, Taejon, 305-343, S. Korea  
SO International Journal of Hydrogen Energy (2001), 26(12), 1263-1269  
CODEN: IJHEDX; ISSN: 0360-3199  
PB Elsevier Science Ltd.  
DT Journal  
LA English  
CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
AB A sulfonated styrene-(ethylene-butylene)-sulfonated styrene (SEBSS) is a highly sulfonated random block polymer. This material has several characteristics including high proton conductivity, good mech. properties, and relatively low cost, but the chemical and temperature stability is lower than that of perfluorinated polymers, such as Nafion due to lower C-H bond association enthalpies of the hydrocarbon framework in polymer. In this paper, we developed the chemical and temperature stability of sulfonated styrene polymer membrane by impregnating silica in these polymers in order to overcome the humidification constraints in direct methanol fuel cell (DMFC). We modified a composite membrane by including a small amount of silica with the aim of retaining the electrochem. produced water inside the cell. A composite sulfonated SEBSS membrane was synthesized by the blending of inorg. materials such as tetra-Et orthosilicate. Membrane cast from this material was investigated in relation to methanol permeability in the range of methanol concentration from

2 to 4 M at 30°C. SEM Photograph revealed a brittle, surface-attached silica layer with silicon oxide contents. The thermal decomposition of a composite membrane was investigated by TG-DSC thermograms. The I-V characteristics of DMFC using a composite membrane as electrolyte was studied with a single cell test equipment at the temperature of 30-90°C. The highest current densities are 74, 229, and 442 mA/cm<sup>2</sup> at temps. 30, 60, and 90°C at a potential of 0.3 V, when small amts. of silica of 0.014 mol was added to SEBSS polymer.

ST methanol fuel cell tetraethyl orthosilicate polymer membrane

IT Fuel cells

Membranes, nonbiological

(performance evaluation of direct methanol fuel cell using impregnated tetra-Et orthosilicate in crosslinked polymer membrane)

IT 67-56-1, Methanol, processes 78-10-4, Tetraethyl orthosilicate 120228-96-8D, hydrogenated, sulfonated

RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)

(performance evaluation of direct methanol fuel cell using impregnated tetra-Et orthosilicate in crosslinked polymer membrane)

RE.CNT 8 THERE ARE 8 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

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L57 ANSWER 41 OF 57 INSPEC (C) 2006 IET on STN

AN 2003:7508202 INSPEC DN A2003-04-8630G-108; B2003-02-8410G-123

TI Composite Nafion membranes for polymer electrolyte and direct methanol fuel cells

AU Antonucci, V.; Staiti, P.; Lufrano, E.; Carbone, A.; Baglio, V.; Passalacqua, E. (Inst. for Transformation & Storage of Energy, CNR, Messina, Italy)

SO New Materials for Electrochemical Systems IV. Extended Abstracts of the Fourth International Symposium on New Materials for Electrochemical Systems, 2001, p. 375-6 of xxiii+488 pp., 2 refs.

Editor(s): Savadogo, O.

Published by: Ecole Polytechnique de Montreal, Montreal, Que., Canada

Conference: Proceedings of Fourth International Symposium on New

Materials for Electrochemical Systems, Montreal, Que., Canada, 9-13 July 2001

DT Conference; Conference Article

TC Experimental

CY Canada

LA English

AB Polymer electrolyte fuel cells (PEFCs) and direct methanol fuel cells (DMFCs), operating at temperatures above 100°C are arousing considerable interest in the perspective of their future application as power sources for electric vehicles. In fact, as well known at this a considerable improvement in cell performance is obtained by increasing the working temperature, due

to the higher electrochemical reactivity and a lower CO poisoning of platinum catalyst. Unfortunately the current perfluorosulfonic membranes do not tolerate temperature > 100°C; the limiting operation temperature is determined by the maintenance of proton conductivity and mechanical characteristics of the electrolyte membranes. It is also known that the conductivity of the polymeric membranes, depends mainly from the amount of water contained in its structure, and thus from the temperature. The approach of the present work consists in the insertion, inside the perfluorosulfonic membrane (Nafion) of an inorganic material (silica) having strong properties of water absorption, able to retain water in the solid electrolyte at temperatures above 100°C.

Moreover, a heteropoly-acid compound, the phosphotungstic acid (PWA) is added to the silica-Nafion membrane as a surface promoter for the electro-oxidation of CO and CO-like species

CC A8630G Fuel cells; A8265F Film and membrane processes; ion exchange; dialysis; osmosis, electro-osmosis; A8245 Electrochemistry and electrophoresis; A6630H Self-diffusion and ionic conduction in solid nonmetals; A8230 Specific chemical reactions; reaction mechanisms; B8410G Fuel cells  
 CT membranes; oxidation; proton exchange membrane fuel cells; silicon compounds; solid electrolytes  
 ST composite Nafion membranes; polymer electrolyte fuel cells; direct methanol fuel cells; power sources; electric vehicles; working temperature; higher electrochemical reactivity; low CO poisoning; limiting operation temperature; proton conductivity; membrane mechanical characteristics; perfluorosulfonic membrane; inorganic material insertion; silica; platinum catalyst; water absorption; solid electrolyte; heteropoly-acid compound; phosphotungstic acid; silica-Nafion membrane; surface promoter; CO electro-oxidation; SiO<sub>2</sub>; CO SiO<sub>2</sub> bin, O<sub>2</sub> bin, Si bin, O bin; CO bin, C bin, O bin  
 CHI C\*O; CO; C cp; cp; O cp; O; Si; C  
 ET

L57 ANSWER 42 OF 57 INSPEC (C) 2006 IET on STN  
 AN 2003:7508178 INSPEC DN A2003-04-8630G-084; B2003-02-8410G-099  
 TI Development of composite membranes for DMFC  
 AU Zaidi, S.M.J.; (Chem. Eng. Dept., King Fahd Univ. of Pet. & Miner., Dhahran, Saudi Arabia), Mikhailenko, S.D.; Kaliaguine, S.  
 SO New Materials for Electrochemical Systems IV. Extended Abstracts of the Fourth International Symposium on New Materials for Electrochemical Systems, 2001, p. 315-16 of xxiii+488 pp., 4 refs.  
 Editor(s): Savadogo, O.  
 Published by: Ecole Polytechnique de Montreal, Montreal, Que., Canada  
 Conference: Proceedings of Fourth International Symposium on New Materials for Electrochemical Systems, Montreal, Que., Canada, 9-13 July 2001  
 DT Conference; Conference Article  
 TC Experimental  
 CY Canada  
 LA English  
 AB Proton exchange membrane fuel cells (PEMFC) are receiving more attention due to the increasing environmental problems caused by combustion engines. In spite of extensive research focused on the development of PEM fuel cell membranes until now there is no real alternative to the presently used Nation membranes produced by Du Pont. When these membranes are used in direct methanol fuel cell (DMFC) they pose a problem of methanol transfer resulting in the reduced cell performance and fuel loss. Moreover, the high cost of Nafion and its lack of conductivity above 100°C set an impediment for the commercialization of this technology. In previous studies a series of

novel low cost composite membranes have been developed for PEM fuel cell applications. The approach followed was that of a composite material, comprising a powdered inorganic acid material (boron phosphate and heteropolyacids) incorporated into sulfonated polyetheretherketone (SPEEK). Here results for the effect of heat treatment on the conductivity of composite membranes containing boron phosphate (BPO<sub>4</sub>) are presented. Also, the effects of adding mesoporous silica on the conductivity of SPEEK membranes are studied. The mesoporous silica may act as a barrier to the diffusion of methanol, in addition to providing better water management in the composite membranes

CC A8630G Fuel cells; A8265F Film and membrane processes; ion exchange; dialysis; osmosis, electro-osmosis; B8410G Fuel cells; B0550 Composite materials (engineering materials science)  
 CT boron compounds; composite materials; membranes; phosphorus compounds; proton exchange membrane fuel cells  
 ST proton exchange membrane fuel cells; direct methanol fuel cell; methanol transfer; reduced cell performance; reduced fuel loss; Nafion; powdered inorganic acid material; boron phosphate; heteropolyacids; sulfonated polyetheretherketone; conductivity; heat treatment; mesoporous silica; methanol diffusion barrier; water management; DMFC; composite membranes; BPO<sub>4</sub>  
 CHI BPO<sub>4</sub> ss, PO<sub>4</sub> ss, O<sub>4</sub> ss, B ss, O ss, P ss  
 ET O\*P; PO; P cp; cp; O; P; C; B\*O\*P; BPO<sub>4</sub>; B cp

L57 ANSWER 43 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
 AN 2001:777683 HCPLUS  
 DN 136:103078  
 ED Entered STN: 26 Oct 2001  
 TI Proton conductivity in siloxane and ormosil ionomers prepared using mild sulfonation methodologies  
 AU Slade, Robert C. T.; Varcoe, John R.  
 CS Department of Chemistry, University of Surrey, Guildford, GU2 7XH, UK  
 SO Solid State Ionics (2001), 145(1-4), 127-133  
 CODEN: SSIOD3; ISSN: 0167-2738  
 PB Elsevier Science B.V.  
 DT Journal  
 LA English  
 CC 37-5 (Plastics Manufacture and Processing)  
 Section cross-reference(s): 73  
 AB Mild sulfonation procedures have been developed for preparation of proton (H<sup>+</sup>) conducting siloxane and ormosil ionomers. Method A involves mild oxidation (with 3-chloroperoxybenzoic acid) of mercapto (-SH) sidechains in siloxane polymers to yield sulfonic acid (-SO<sub>3</sub>H) groups. Method B involves the formation of copolymers of a methacrylate-containing siloxane and a novel protected styrene sulfonated precursor (NISS, 1,2,3,4-tetrahydro-1-naphthylideneamino p-styrenesulfonate), with subsequent deprotection by UV irradiation and acidification. Proton conductivities of materials from these two routes have been studied as functions of temperature and of relative humidity. Conductivities follow an empirical Arrhenius law and increase markedly in moist atmospheres. Conductivities at elevated temps. are at least as high as those for Nafion membranes under similar conditions.  
 ST polysiloxane silsesquioxane sulfonic ionomer proton cond humidity  
 IT Silsesquioxanes  
 RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)  
 (ionomers; proton conductivity in siloxane and ormosil ionomers prepared using

- mild sulfonation methodologies)
- IT Silsesquioxanes  
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)  
(polysiloxane-, ionomers; proton conductivity in siloxane and ormosil ionomers prepared using mild sulfonation methodologies)
- IT Ionomers  
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); PROC (Process)  
(proton conductivity in siloxane and ormosil ionomers prepared using mild sulfonation methodologies)
- IT Ionic conductivity  
(proton; proton conductivity in siloxane and ormosil ionomers prepared using mild sulfonation methodologies)
- IT Polysiloxanes, preparation  
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)  
(silsesquioxane-, ionomers; proton conductivity in siloxane and ormosil ionomers prepared using mild sulfonation methodologies)
- IT 937-14-4, 3-Chloroperoxybenzoic acid  
RL: RCT (Reactant); RACT (Reactant or reagent)  
(oxidation agent; proton conductivity in siloxane and ormosil ionomers prepared using mild sulfonation methodologies)
- IT 30586-48-2DP, Diethoxydimethylsilane-3-(mercaptopropyl)trimethoxysilane copolymer, oxidized 256473-64-0DP, 3-(Mercaptopropyl)methyldimethoxysilane-3-(mercaptopropyl)trimethoxysilane copolymer, oxidized 271778-35-9DP, hydrolyzed  
RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC (Process)  
(proton conductivity in siloxane and ormosil ionomers prepared using mild sulfonation methodologies)
- RE.CNT 20 THERE ARE 20 CITED REFERENCES AVAILABLE FOR THIS RECORD
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(20) Zoppi, R; J Electroanal Chem 1998, V445, P39 HCPLUS  
 IT 30586-48-2DP, Diethoxydimethylsilane-3-(  
 mercaptopropyl)trimethoxysilane copolymer, oxidized  
 256473-64-0DP, 3-(Mercaptopropyl)  
 methyldimethoxysilane-3-(mercaptopropyl)  
 trimethoxysilane copolymer, oxidized  
 RL: PEP (Physical, engineering or chemical process); PRP (Properties); PYP  
 (Physical process); SPN (Synthetic preparation); PREP (Preparation); PROC  
 (Process)  
 (proton conductivity in siloxane and ormosil ionomers prepared using mild  
 sulfonation methodologies)

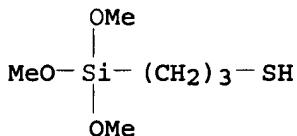
RN 30586-48-2 HCPLUS

CN 1-Propanethiol, 3-(trimethoxysilyl)-, polymer with diethoxydimethylsilane  
 (8CI, 9CI) (CA INDEX NAME)

CM 1

CRN 4420-74-0

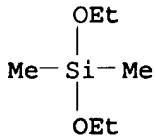
CMF C6 H16 O3 S Si



CM 2

CRN 78-62-6

CMF C6 H16 O2 Si



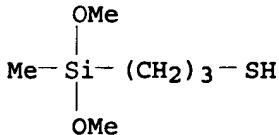
RN 256473-64-0 HCPLUS

CN 1-Propanethiol, 3-(dimethoxymethylsilyl)-, polymer with  
 3-(trimethoxysilyl)-1-propanethiol (9CI) (CA INDEX NAME)

CM 1

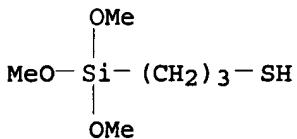
CRN 31001-77-1

CMF C6 H16 O2 S Si



CM 2

CRN 4420-74-0  
 CMF C6 H16 O3 S Si



L57 ANSWER 44 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN DUPLICATE 6  
 AN 2001:777680 HCPLUS  
 DN 136:186521  
 ED Entered STN: 26 Oct 2001  
 TI Hybrid Nafion-silica membranes doped with heteropoly acids for application in direct methanol fuel cells  
 AU Staiti, P.; Arico, A. S.; Baglio, V.; Lufrano, F.; Passalacqua, E.; Antonucci, V.  
 CS Institute CNR for Transformation and Storage of Energy, St. Lucia, Messina, 98126, Italy  
 SO Solid State Ionics (2001), 145(1-4), 101-107  
 CODEN: SSIOD3; ISSN: 0167-2738  
 PB Elsevier Science B.V.  
 DT Journal  
 LA English  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 AB Nafion-silica composite membranes doped with phosphotungstic and silicotungstic acids have been investigated for application in direct methanol fuel cells at high temperature (145°C). The phosphotungstic acid-based membrane showed better electrochem. characteristics at high current densities with respect to both silicotungstic acid-modified membrane and silica-Nafion membrane. A maximum power d. of 400 mW cm-2 was obtained at 145°C in the presence of oxygen feed, whereas the maximum power d. in the presence of air feed was approaching 250 mW cm-2. The addition of inorg. hygroscopic materials to recast Nafion extends the operating range of a direct methanol fuel cell. Operation at high temps. significantly enhances the kinetics of methanol oxidation  
 ST methanol fuel cell Nafion silica membrane heteropoly acid  
 IT Fuel cells  
 Membranes, nonbiological  
 (hybrid Nafion-silica membranes doped with heteropolyacids for application in direct methanol fuel cells)  
 IT Heteropoly acids  
 RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)  
 (hybrid Nafion-silica membranes doped with heteropolyacids for application in direct methanol fuel cells)  
 IT Ionomers  
 RL: PEP (Physical, engineering or chemical process); PRP (Properties); PROC (Process)  
 (polyoxyalkylenes, fluorine- and sulfo-containing; hybrid Nafion-silica membranes doped with heteropolyacids for application in direct methanol fuel cells)  
 IT 67-56-1, Methanol, processes 1343-93-7, Phosphotungstic acid

7631-86-9, Silica, processes 12027-38-2, Silicotungstic acid  
 RL: PEP (Physical, engineering or chemical process); PRP (Properties);  
 PROC (Process)

(hybrid Nafion-silica membranes doped with heteropolyacids  
 for application in direct methanol fuel cells)

RE.CNT 10 THERE ARE 10 CITED REFERENCES AVAILABLE FOR THIS RECORD

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- (5) Giordano, N; Electrochim Acta 1993, V38, P1733 HCAPLUS
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- (10) Tazi, B; Proceedings of the Second International Symposium on New Materials for Fuel Cell and Modern Battery Systems 1997, P864 HCAPLUS

L57 ANSWER 45 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN DUPLICATE 7.

AN 2001:284491 HCAPLUS

DN 135:79349

ED Entered STN: 22 Apr 2001

TI Chemical modification of proton exchange membrane fuel cell catalysts with a sulfonated silane

AU Easton, E. Bradley; Qi, Zhigang; Kaufman, Arthur; Pickup, Peter G.

CS Department of Chemistry, Memorial University of Newfoundland, St. John's, NF, A1B 3X7, Can.

SO Electrochemical and Solid-State Letters (2001), 4(5), A59-A61

CODEN: ESLEF6; ISSN: 1099-0062

PB Electrochemical Society

DT Journal

LA English

CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)

AB The surface modification of carbon supported Pt fuel cell catalysts by attachment of a sulfonated silane is reported. Attachment of the silane to the carbon surface before Pt deposition yields higher performances than attachment after Pt deposition. Optimum performances for both types of modified catalyst were reached at a 10% Nafion loading in the fuel cell catalyst layer, and were significantly better than that for an untreated standard catalyst at 10% Nafion loading. However, the optimum performance of the untreated catalyst, at 30% Nafion loading, was slightly better than that of the best treated catalyst. These results are explained by the fact that both optimized catalyst layers contained approx. the same concentration of sulfonate groups.

ST fuel cell cathode sulfonated silane

IT Fuel cell cathodes

Fuel cells

(chemical modification of proton exchange membrane fuel cell catalysts with a sulfonated silane)

IT 79793-00-3, 2(4-Chlorosulfonylphenyl)ethyl trichlorosilane

RL: DEV (Device component use); USES (Uses)

(chemical modification of proton exchange membrane fuel cell catalysts with a sulfonated silane)

RE.CNT 7 THERE ARE 7 CITED REFERENCES AVAILABLE FOR THIS RECORD

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L57 ANSWER 46 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
AN 2002:490481 HCPLUS  
DN 137:297284  
ED Entered STN: 30 Jun 2002  
TI Polymer-silica composite membranes for direct methanol fuel cells  
AU Antonucci, V.; Arico, A. S.; Modica, E.; Creti, P.; Staiti, P.; Antonucci, P. L.  
CS Institute CNR-TAE, S. Lucia, Messina, 98126, Italy  
SO Studies in Surface Science and Catalysis (2001), 140(Oxide-Based Systems at the Crossroads of Chemistry), 37-45  
CODEN: SSCTDM; ISSN: 0167-2991  
PB Elsevier Science B.V.  
DT Journal  
LA English  
CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
AB Heteropolyacid-modified polymer silica membranes for Direct Methanol Fuel Cells have been prepared and tested under high temperature operation conditions (145°C) in single cell configuration. A maximum power d. of 0.4 W/cm<sup>2</sup> in oxygen with 2 M methanol has been obtained; with air at the cathode, this value decreased to 0.25 W/cm<sup>2</sup>. The higher performance of the heteropolyacid-Nafion-silica membrane, with respect to Nafion-silica, is attributed to its better ion transport properties, since the measured cell resistance value is similar for both membranes.  
ST methanol fuel cell membrane heteropolyacid  
Nafion silica  
IT Polyoxyalkylenes, processes  
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PROC (Process)  
(fluorine- and sulfo-containing, ionomers; polymer-silica composite membranes for direct methanol fuel cells)  
IT Fuel cell separators  
(polymer-silica composite membranes for direct methanol fuel cells)  
IT Fluoropolymers, processes  
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PROC (Process)  
(polyoxyalkylene-, sulfo-containing, ionomers; polymer-silica composite membranes for direct methanol fuel cells)  
IT Ionomers  
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PROC (Process)  
(polyoxyalkylenes, fluorine- and sulfo-containing; polymer-silica composite membranes for direct methanol fuel cells)  
IT 67-56-1, Methanol, processes 1343-93-7, Phosphotungstic acid  
7631-86-9, Silica, processes  
RL: CPS (Chemical process); PEP (Physical, engineering or chemical process); PROC (Process)  
(polymer-silica composite membranes for direct methanol fuel cells)

RE.CNT 25 THERE ARE 25 CITED REFERENCES AVAILABLE FOR THIS RECORD  
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L57 ANSWER 47 OF 57 INSPEC (C) 2006 IET on STN  
 AN 2001:7008185 INSPEC DN A2001-18-8265-009; B2001-09-8410G-055  
 TI Chemical modification of proton exchange membrane fuel  
 cell catalysts with a sulfonated silane  
 AU Easton, E.B.; (Dept. of Chem., Memorial Univ. of Newfoundland, St.  
 John's, Nfld., Canada), Zhigang Qi; Kaufman, A.; Pickup, P.G.  
 SO Electrochemical and Solid-State Letters (May 2001), vol.4, no.5, p.  
 A59-61, 7 refs.  
 CODEN: ESLEF6, ISSN: 1099-0062  
 SICI: 1099-0062(200105)4:5L.a59:CMPE;1-6  
 Price: 1099-0062/2001/4(5)/59/3/\$7.00  
 Doc.No.: S1099-0062(01)01405-5  
 Published by: Electrochim. Soc, USA  
 DT Journal  
 TC Experimental  
 CY United States  
 LA English  
 AB The surface modification of carbon supported Pt fuel  
 cell catalysts by attachment of a sulfonated  
 silane is reported. Attachment of the silane to the carbon  
 surface before Pt deposition yields higher performances than attachment  
 after Pt deposition. Optimum performances for both types of modified  
 catalyst were reached at a 10% Nafion loading in the  
 fuel cell catalyst layer, and were significantly better  
 than that for an untreated standard catalyst at 10% Nafion  
 loading. However, the optimum performance of the untreated catalyst, at  
 30% Nafion loading, was slightly better than that of the best  
 treated catalyst. These results are explained by the fact that both  
 optimized catalyst layers contained approximately the same concentration  
 of sulfonate groups  
 CC A8265J Heterogeneous catalysis at surfaces and other surface reactions;  
 A8630G Fuel cells; B8410G Fuel cells  
 CT carbon; catalysts; platinum; proton exchange membrane fuel  
 cells; surface chemistry  
 ST proton exchange membrane fuel cell catalysts; sulfonated silane; surface

modification; C supported Pt fuel cell catalysts; Nafion loading; Pt; C  
 CHI Pt el; C el  
 ET Pt

L57 ANSWER 48 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
 AN 2000:615568 HCPLUS  
 DN 133:354847  
 ED Entered STN: 06 Sep 2000  
 TI Optical sensor for seawater salinity  
 AU Huber, Christian; Klimant, I.; Krause, Christian; Werner, Tobias; Mayr, Torsten; Wolfbeis, Otto S.  
 CS Institute of Analytical Chemistry, Chemo- and Biosensors, University of Regensburg, Regensburg, 93040, Germany  
 SO Fresenius' Journal of Analytical Chemistry (2000), 368(2-3), 196-202  
 CODEN: FJACES; ISSN: 0937-0633  
 PB Springer-Verlag  
 DT Journal  
 LA English  
 CC 61-3 (Water)  
 Section cross-reference(s): 79  
 AB An optical sensor for the measurement of salinity in seawater was developed. It is based on a chloride-quenchable fluorescent probe (lucigenin) immobilized on a Nafion film. Two approaches for measuring salinity via chloride concentration are presented. In the first, a change in salinity corresponds to a change in the fluorescence intensity of lucigenin. In the second, the fluorescence intensity information is converted into a phase angle information by adding an inert phosphorescent reference luminophor (a ruthenium complex entrapped in poly(acrylonitrile) beads). Under these conditions, the chloride-dependent fluorescence intensity of lucigenin can be converted into a chloride-dependent fluorescence phase shift which serves as the anal. information. This scheme is referred to as dual lifetime referencing (DLR). The sensor was used to determine the salinity in seawater and brackish water of the North Sea.  
 ST salinity optical sensor lucigenin Nafion membrane;  
 seawater salinity optical sensor lucigenin Nafion  
 IT Waters  
 (brackish; development of optical sensor for salinity of)  
 IT Seawater  
 (development of optical sensor for salinity of)  
 IT Optical sensors  
 (development of optical sensor for seawater salinity)  
 IT Salts, analysis  
 RL: ANT (Analyte); ANST (Analytical study)  
 (development of optical sensor for seawater salinity)  
 IT Polyoxyalkylenes, analysis  
 RL: ARU (Analytical role, unclassified); DEV (Device component use); ANST (Analytical study); USES (Uses)  
 (fluorine- and sulfo-containing, ionomers, membranes; development of optical sensor for seawater salinity based on)  
 IT Polyoxyalkylenes, analysis  
 RL: ARU (Analytical role, unclassified); DEV (Device component use); ANST (Analytical study); USES (Uses)  
 (fluorine-containing, sulfo-containing, ionomers, membranes; development of optical sensor for seawater salinity based on)  
 IT Fluoropolymers, analysis  
 Fluoropolymers, analysis  
 RL: ARU (Analytical role, unclassified); DEV (Device component use); ANST (Analytical study); USES (Uses)  
 (polyoxyalkylene-, sulfo-containing, ionomers, membranes; development of optical sensor for seawater salinity based on)

IT Ionomers  
RL: ARU (Analytical role, unclassified); DEV (Device component use); ANST (Analytical study); USES (Uses)  
(polyoxyalkylenes, fluorine- and sulfo-containing, membranes;  
development of optical sensor for seawater salinity based on)

IT 7732-18-5, Water, analysis  
RL: AMX (Analytical matrix); ANST (Analytical study)  
(development of optical sensor for seawater salinity)

IT 16887-00-6, Chloride, analysis  
RL: ANT (Analyte); ANST (Analytical study)  
(development of optical sensor for seawater salinity via)

IT 2315-97-1, Lucigenin  
RL: ARG (Analytical reagent use); DEV (Device component use); ANST (Analytical study); USES (Uses)  
(fluorescent probe; development of optical sensor for seawater salinity  
based on)

IT 158273-63-3  
RL: ARU (Analytical role, unclassified); DEV (Device component use); ANST (Analytical study); USES (Uses)  
(reference luminophor; development of optical sensor for seawater salinity  
containing)

RE.CNT 27 THERE ARE 27 CITED REFERENCES AVAILABLE FOR THIS RECORD

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IT 158273-63-3

RL: ARU (Analytical role, unclassified); DEV (Device component use); ANST (Analytical study); USES (Uses)  
(reference luminophor; development of optical sensor for seawater salinity  
containing)

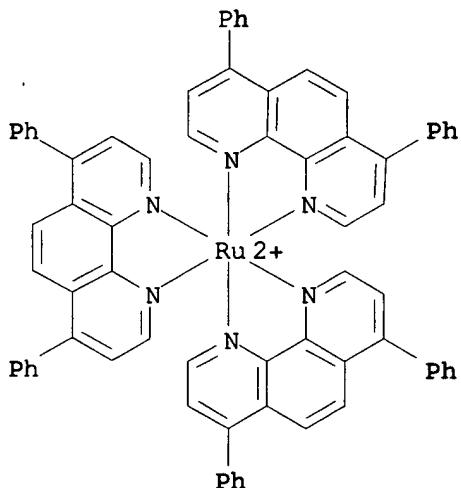
RN 158273-63-3 HCPLUS

CN Ruthenium(2+), tris(4,7-diphenyl-1,10-phenanthroline-κN1,κN10)-  
, (OC-6-11)-, salt with 3-(trimethylsilyl)-1-propanesulfonic acid (1:2)

(9CI) (CA INDEX NAME)

CM 1

CRN 63373-04-6  
 CMF C72 H48 N6 Ru  
 CCI CCS



CM 2

CRN 59906-89-7  
 CMF C6 H15 O3 S Si

 $\text{Me}_3\text{Si}-\text{(CH}_2)_3-\text{SO}_3^-$ 

L57 ANSWER 49 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
 AN 1999:425726 HCPLUS  
 DN 131:61143  
 ED Entered STN: 09 Jul 1999  
 TI Polymeric membrane electrochemical cell operating at temperatures above 100°  
 IN Antonucci, Vincenzo; Arico, Antonino  
 PA De Nora S.p.A., Italy; Nuvera Fuel Cells Europ Srl.  
 SO Eur. Pat. Appl., 6 pp.  
 CODEN: EPXXDW  
 DT Patent  
 LA English  
 IC ICM H01M008-02  
 ICS H01M008-10; C08J005-22  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 38  
 FAN.CNT 1

| PATENT NO. | KIND | DATE     | APPLICATION NO. | DATE     |
|------------|------|----------|-----------------|----------|
| EP 926754  | A1   | 19990630 | EP 1998-123433  | 19981209 |
| EP 926754  | B1   | 20030423 |                 |          |

R: AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LI, LU, NL, SE, MC, PT,  
IE, SI, LT, LV, FI, RO

|                     |    |          |                 |          |
|---------------------|----|----------|-----------------|----------|
| US 6156184          | A  | 20001205 | US 1998-206849  | 19981207 |
| CA 2255515          | AA | 19990610 | CA 1998-2255515 | 19981208 |
| JP 11250922         | A2 | 19990917 | JP 1998-349825  | 19981209 |
| ES 2198030          | T3 | 20040116 | ES 1998-123433  | 19981209 |
| US 6780537          | B1 | 20040824 | US 2000-702322  | 20001031 |
| PRAI IT 1997-MI2733 | A  | 19971210 |                 |          |
| US 1998-206849      | A3 | 19981207 |                 |          |

## CLASS

| PATENT NO.  | CLASS  | PATENT FAMILY CLASSIFICATION CODES  |  |  |
|-------------|--|---|--|--|
| EP 926754   | ICM  | H01M008-02  |  |  |
|             | ICS  | H01M008-10; C08J005-22  |  |  |
|             | IPCI   | H01M0008-02 [ICM,6]; H01M0008-10 [ICS,6]; C08J0005-22<br>[ICS,6]; C08J0005-20 [ICS,6,C*]                                  |  |  |
|             | IPCR   | C08J0005-20 [I,C*]; C08J0005-22 [I,A]; H01M0008-02<br>[I,A]; H01M0008-02 [I,C*]; H01M0008-10 [I,A];<br>H01M0008-10 [I,C*] |  |  |
|             | ECLA   | C08J005/22B2B2B; C08J005/22B2B2; C08J005/22B2B1;<br>H01M008/02E2; H01M008/10E2  |  |  |
| US 6156184  | IPCI   | C25B0001-00 [ICM,7]   |  |  |
|             | NCL  | 205/334.000; 204/263.000; 204/296.000; 205/343.000  |  |  |
|             | ECLA   | C08J005/22B2B1; C08J005/22B2B2; C08J005/22B2B2;<br>H01M008/02E2; H01M008/10E2   |  |  |
| CA 2255515  | IPCI   | H01M0002-14 [ICM,6]; H01M0008-12 [ICS,6]  |  |  |
|             | IPCR   | C08J0005-20 [I,C*]; C08J0005-22 [I,A]; H01M0008-02<br>[I,A]; H01M0008-02 [I,C*]; H01M0008-10 [I,A];<br>H01M0008-10 [I,C*] |  |  |
| JP 11250922 | IPCI   | H01M0008-02 [ICM,6]; H01M0008-06 [ICS,6]  |  |  |
|             | IPCR   | C08J0005-20 [I,C*]; C08J0005-22 [I,A]; H01M0008-02<br>[I,A]; H01M0008-02 [I,C*]; H01M0008-10 [I,A];<br>H01M0008-10 [I,C*] |  |  |
| ES 2198030  | IPCI   | H01M0008-02 [ICM,7]; H01M0008-10 [ICS,7]; C08J0005-22<br>[ICS,7]; C08J0005-20 [ICS,7,C*]                                  |  |  |
|             | IPCR   | C08J0005-20 [I,C*]; C08J0005-22 [I,A]; H01M0008-02<br>[I,A]; H01M0008-02 [I,C*]; H01M0008-10 [I,A];<br>H01M0008-10 [I,C*] |  |  |
| US 6780537  | IPCI   | H01M0008-10 [ICM,7]   |  |  |
|             | IPCR   | C08J0005-20 [I,C*]; C08J0005-22 [I,A]; H01M0008-02<br>[I,A]; H01M0008-02 [I,C*]; H01M0008-10 [I,A];<br>H01M0008-10 [I,C*] |  |  |
|             | NCL  | 429/041.000; 429/030.000; 429/033.000   |  |  |
|             | ECLA   | C08J005/22B2B1; C08J005/22B2B2; C08J005/22B2B2;<br>H01M008/02E2; H01M008/10E2   |  |  |
| AB          | A proton exchange membrane comprising a perfluorosulfonic acid having silica particles embedded therein in a concentration by weight comprised between 0.01 and 50% by weight and dimensions comprised between 0.001 and 10 µm, characterized in that the membrane comprises both an amorphous and a crystalline phase and the ratio thereof is adjusted by a controlled thermal treatment at a temperature higher than the glass transition temperature, controlled by an x-ray spectrometer. The invention further concerns an electrochem. cell using the membrane, in particular a fuel cell and the method of operating the same. |   |  |  |
| ST          | fuel cell polymer membrane   |   |  |  |
| IT          | Alcohols, reactions<br>Hydrocarbons, reactions   |   |  |  |
|             | RL: RCT (Reactant); RACT (Reactant or reagent)   |   |  |  |
|             | (H from; polymeric membrane electrochem. cell operating at temps. above 100°)  |   |  |  |

IT Polyoxyalkylenes, uses  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (fluorine- and sulfo-containing, ionomers; polymeric membrane electrochem.  
 cell operating at temps. above 100°)

IT Polyoxyalkylenes, uses  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (fluorine-containing, sulfo-containing, ionomers; polymeric membrane  
 electrochem. cell operating at temps. above 100°)

IT Fuel cells  
 Membranes, nonbiological  
 (polymeric membrane electrochem. cell operating at temps. above  
 100°)

IT Fluoropolymers, uses  
 Fluoropolymers, uses  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (polyoxyalkylene-, sulfo-containing, ionomers; polymeric membrane  
 electrochem. cell operating at temps. above 100°)

IT Ionomers  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (polyoxyalkylenes, fluorine- and sulfo-containing; polymeric membrane  
 electrochem. cell operating at temps. above 100°)

IT 7440-06-4, Platinum, uses 7440-18-8, Ruthenium, uses  
 RL: CAT (Catalyst use); USES (Uses)  
 (polymeric membrane electrochem. cell operating at temps. above  
 100°)

IT 64-17-5, Ethanol, uses 67-56-1, Methanol, uses 1333-74-0, Hydrogen,  
 uses 7631-86-9, Silica, uses 77950-55-1, Nafion 115  
 RL: TEM (Technical or engineered material use); USES (Uses)  
 (polymeric membrane electrochem. cell operating at temps. above  
 100°)

RE.CNT 2 THERE ARE 2 CITED REFERENCES AVAILABLE FOR THIS RECORD

RE

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IT 77950-55-1, Nafion 115

RL: TEM (Technical or engineered material use); USES (Uses)  
 (polymeric membrane electrochem. cell operating at temps. above  
 100°)

RN 77950-55-1 HCPLUS

CN Nafion 115 (9CI) (CA INDEX NAME)

\*\*\* STRUCTURE DIAGRAM IS NOT AVAILABLE \*\*\*

L57 ANSWER 50 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
 AN 1998:45420 HCPLUS  
 DN 128:102793  
 ED Entered STN: 28 Jan 1998  
 TI Hybrids of perfluorosulfonic acid ionomer and silicon oxide by sol-gel  
 reaction from solution: morphology and thermal analysis  
 AU Zoppi, R. A.; Yoshida, I. V. P.; Nunes, S. P.  
 CS University of Campinas, Institute of Chemistry, Campinas, 13083-970,  
 Brazil  
 SO Polymer (1998), 39(6-7), 1309-1315  
 CODEN: POLMAG; ISSN: 0032-3861  
 PB Elsevier Science Ltd.  
 DT Journal  
 LA English  
 CC 37-5 (Plastics Manufacture and Processing)  
 AB Nafion 1100 EW/silicon oxide hybrids were prepared from solution by  
 hydrolysis/polycondensation of alkoxy silanes. Transparent, but brittle

films were obtained when TEOS was used as the inorg. polymer precursor, and the films have a lamellar structure as established by TEM. Part of the TEOS was substituted by TMDES to increase the film flexibility. For substitution higher than 10%, phase separation was clearly observed by scanning and TEM. The thermal anal. of Nafion and hybrids with different inorg. content showed two main endothermic transitions, one assigned to the Nafion ionic clusters and the other to the melting of the perfluorinated matrix. The cluster transition temperature decreased as the

TEOS

content increased up to 50%, but then increased as the TEOS content reached 80%. The hybrids have potential for use as gas separation membranes and as ion carriers.

ST

fluorosulfonic acid ionomer silica hybrid prep; sol gel alkoxysilane condensation perfluorosulfonate;

flexibility morphol silica perfluorosulfonate ionomer hybrid

IT

Polyoxyalkylenes, properties

RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses) (fluorine- and sulfo-containing, ionomers, Nafion; morphol. and phase transition of hybrids of perfluorosulfonic acid ionomer and silica prepared by sol-gel condensation of TEOS on Nafion)

IT

Polyoxyalkylenes, properties

RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses) (fluorine-containing, sulfo-containing, ionomers, Nafion; morphol. and phase transition of hybrids of perfluorosulfonic acid ionomer and silica prepared by sol-gel condensation of TEOS on Nafion)

IT

Flexibility

Phase separation

Phase transition temperature

Polymer morphology

(morphol. and phase transition of hybrids of perfluorosulfonic acid ionomer and silica prepared by sol-gel condensation of TEOS on Nafion)

IT

Fluoropolymers, properties

Fluoropolymers, properties

RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses) (polyoxyalkylene-, sulfo-containing, ionomers, Nafion; morphol. and phase transition of hybrids of perfluorosulfonic acid ionomer and silica prepared by sol-gel condensation of TEOS on Nafion)

IT

Ionomers

RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses) (polyoxyalkylenes, fluorine- and sulfo-containing, Nafion; morphol. and phase transition of hybrids of perfluorosulfonic acid ionomer and silica prepared by sol-gel condensation of TEOS on Nafion)

IT

7631-86-9P, Silica, preparation

RL: PEP (Physical, engineering or chemical process); PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); PROC (Process); USES (Uses) (morphol. and phase transition of hybrids of perfluorosulfonic acid ionomer and silica prepared by sol-gel condensation of TEOS on Nafion)

IT

93615-63-5, Nafion 1100

RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses) (morphol. and phase transition of hybrids of perfluorosulfonic acid ionomer and silica prepared by sol-gel condensation of TEOS on

**Nafion)**

IT 78-10-4D, TEOS, hydrolyzed 18420-09-2D, 1,1,3,3-Tetramethyl-1,3-diethoxydisiloxane, hydrolyzed  
 RL: PEP (Physical, engineering or chemical process); RCT (Reactant); PROC (Process); RACT (Reactant or reagent)  
 (morphol. and phase transition of hybrids of perfluorosulfonic acid ionomer and silica prepared by sol-gel condensation of TEOS on Nafion)

RE.CNT 21 THERE ARE 21 CITED REFERENCES AVAILABLE FOR THIS RECORD

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L57 ANSWER 51 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN

AN 1998:91204 HCAPLUS

DN 128:141384

ED Entered STN: 18 Feb 1998

TI Infrared investigation of the silicon oxide phase in [perfluoro-carboxylate/sulfonate (bilayer)]/[silicon oxide] nanocomposite membranes

AU Robertson, M. A. F.; Mauritz, K. A.

CS Department of Polymer Science, University of Southern Mississippi, Hattiesburg, MS, 39406-0076, USA

SO Journal of Polymer Science, Part B: Polymer Physics (1998), 36(4), 595-606  
 CODEN: JPBPEM; ISSN: 0887-6266

PB John Wiley & Sons, Inc.

DT Journal

LA English

CC 37-5 (Plastics Manufacture and Processing)

Section cross-reference(s): 38, 57

AB [Perfluoro-organic]/[silicon oxide] hybrids were formed via sol-gel reactions of tetraethylorthosilicate within a perfluoro(carboxylate/sulfonate) [Nafion and 1100 EW Nafion] bilayer membrane in the Co+2 form. FTIR and 29Si solid-state NMR spectroscopies were used to study the mol. structure within the silicon oxide phase as a function of its relative content. The internal gel structure is considerably un-connected in terms of the population of Si-O-Si groups in cyclic vs. linear substructures and degree of Si atom coordination about bonded SiO<sub>4</sub> units. In situ (HO)<sub>x</sub>SiO<sub>2</sub>[1-1/4x] intra-structure becomes increasingly less

connected and more strained with regard to bonding geometry with increasing silicon oxide content. Structural differences are seen between the silicon oxide component incorporated in carboxylate and sulfonate layers. These inorganically modified perfluorinated ionomers have potential as fast-proton conducting membranes for fuel cells and as permselective membranes in liquid pervaporation cells.

ST silica perfluorocarboxylate sulfonate hybrid bilayer membrane; nanocomposite membrane silica polymer hybrid composite; sol gel hybrid composite silica fluoropolymer

IT Polyoxyalkylenes, properties

RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses) (fluorine- and sulfo-containing, ionomers, cobalt complexes, TEOS derivs.; silicon oxide phase structure in fluoropolymer bilayer membrane/silicon oxide hybrid nanocomposites obtained via sol-gel processing)

IT Polyoxyalkylenes, properties

RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses) (fluorine-containing, sulfo-containing, ionomers, cobalt complexes, TEOS derivs.; silicon oxide phase structure in fluoropolymer bilayer membrane/silicon oxide hybrid nanocomposites obtained via sol-gel processing)

IT Polymer morphology

(nanostructures; silicon oxide phase structure in fluoropolymer bilayer membrane/silicon oxide hybrid nanocomposites obtained via sol-gel processing)

IT Membranes, nonbiological

(permselective; silicon oxide phase structure in fluoropolymer bilayer membrane/silicon oxide hybrid nanocomposites obtained via sol-gel processing)

IT Fluoropolymers, properties

Fluoropolymers, properties  
RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses) (polyoxyalkylene-, sulfo-containing, ionomers, cobalt complexes, TEOS derivs.; silicon oxide phase structure in fluoropolymer bilayer membrane/silicon oxide hybrid nanocomposites obtained via sol-gel processing)

IT Ionomers

RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses) (polyoxyalkylenes, fluorine- and sulfo-containing, cobalt complexes, TEOS derivs.; silicon oxide phase structure in fluoropolymer bilayer membrane/silicon oxide hybrid nanocomposites obtained via sol-gel processing)

IT Membranes, nonbiological

(proton conducting; silicon oxide phase structure in fluoropolymer bilayer membrane/silicon oxide hybrid nanocomposites obtained via sol-gel processing)

IT Molecular structure

(silica phases and nanostructures; silicon oxide phase structure in fluoropolymer bilayer membrane/silicon oxide hybrid nanocomposites obtained via sol-gel processing)

IT Bilayer membranes

Hybrid organic-inorganic materials

Nanocomposites

Nanostructures

Sol-gel processing

(silicon oxide phase structure in fluoropolymer bilayer membrane/silicon oxide hybrid nanocomposites obtained via sol-gel

- processing)
- IT 78-10-4D, Tetraethylorthosilicate, reaction products with fluoropolymer cobalt complex membranes 63496-24-2D, Nafion EW 1100, cobalt complexes, reaction products with tetraethylorthosilicate  
 RL: PEP (Physical, engineering or chemical process); PRP (Properties); TEM (Technical or engineered material use); PROC (Process); USES (Uses)  
 (silicon oxide phase structure in fluoropolymer bilayer membrane/silicon oxide hybrid nanocomposites obtained via sol-gel processing)
- IT 7631-86-9P, Silicon oxide, preparation  
 RL: PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
 (silicon oxide phase structure in fluoropolymer bilayer membrane/silicon oxide hybrid nanocomposites obtained via sol-gel processing)

RE.CNT 20 THERE ARE 20 CITED REFERENCES AVAILABLE FOR THIS RECORD

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- (18) Quezado, S; Can J Chem 1984, V62, P958 HCPLUS
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- (20) Twardowski, Z; J Electrochem Soc 1982, V129, P328 HCPLUS

L57 ANSWER 52 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN

AN 1996:181064 HCPLUS

DN 124:291450

ED Entered STN: 28 Mar 1996

TI [Perfluorosulfonate ionomer]/[SiO<sub>2</sub>-TiO<sub>2</sub>] nanocomposites via polymer-in situ sol-gel chemistry: sequential alkoxide procedure

AU Shao, P. L.; Mauritz, K. A.; Moore, R. B.

CS Department Polymer Science, University Southern Mississippi, Hattiesburg, MS, 39406-0076, USA

SO Journal of Polymer Science, Part B: Polymer Physics (1996), 34(5), 873-82  
 CODEN: JPBPEM; ISSN: 0887-6266

PB Wiley

DT Journal

LA English

CC 38-3 (Plastics Fabrication and Uses)

AB In situ sol-gel chemical was used to create inorg./perfluoro-organic hybrids wherein titanium oxide outer regions of SiO<sub>2</sub>[1-x/4](OH)<sub>x</sub> nanoparticles, which were preformed in Nafion membranes, were created by postreaction with tetrabutyltitanate (TBT). U-shaped Si and Ti distributions across the membrane thickness direction were determined via x-ray energy dispersive spectroscopy. Ti/Si ratio profiles are also

U-shaped, indicating more Ti relative to Si in near-surface regions. IR spectroscopy verified structural bonding of TiO<sub>4</sub> units onto SiO<sub>2</sub> nanoparticles and indicated that alkoxide hydrolysis is not complete. Reacted silicon oxide nanophases retain the topol. unconnectedness possessed by the corresponding unreacted phase. IR bands signifying mol. loops and linear fragments of Si-O-Si groups are seen. <sup>29</sup>Si solid-state NMR spectroscopy indicated that, for an inorg. uptake of 16.3 wt%, the Q3 state of SiO<sub>4</sub> is most populated although Q4 is only slightly less prominent and Q2 and Q1 are either small or absent. The silicon oxide component, although not being predominantly linear, retains a measure of uncondensed SiOH groups. Tensile stress vs. strain analyses suggested that TBT postreaction links nanoparticles, causing them to be contiguous over considerable distances. This percolative intergrowth occurs in near-surface regions generating a glassy zone.

ST Nafion ionomer silica titania nanocomposite membrane

IT Membranes

(preparation of perfluorosulfonate ionomer/[SiO<sub>2</sub>-TiO<sub>2</sub>] nanocomposites via polymer-in situ sol-gel sequential alkoxide procedure)

IT Polyoxyalkylenes, uses

RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)

(fluorine- and sulfo-containing, ionomers, preparation of perfluorosulfonate ionomer/[SiO<sub>2</sub>-TiO<sub>2</sub>] nanocomposites via polymer-in situ sol-gel sequential alkoxide procedure)

IT Fluoropolymers

RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)

(polyoxyalkylene-, sulfo-containing, ionomers, preparation of perfluorosulfonate

ionomer/[SiO<sub>2</sub>-TiO<sub>2</sub>] nanocomposites via polymer-in situ sol-gel sequential alkoxide procedure)

IT Ionomers

RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)

(polyoxyalkylenes, fluorine- and sulfo-containing, preparation of perfluorosulfonate ionomer/[SiO<sub>2</sub>-TiO<sub>2</sub>] nanocomposites via polymer-in situ sol-gel sequential alkoxide procedure)

IT 69013-31-6, Tetraethoxysilane-tetrabutyl titanate copolymer

RL: PRP (Properties); TEM (Technical or engineered material use); USES (Uses)

(preparation of perfluorosulfonate ionomer/[SiO<sub>2</sub>-TiO<sub>2</sub>] nanocomposites via polymer-in situ sol-gel sequential alkoxide procedure)

L57 ANSWER 53 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN

AN 1996:244857 HCPLUS

DN 124:291092

ED Entered STN: 25 Apr 1996

TI An infrared investigation of the silicon oxide phase in [perfluorinated ionomer]/[inorganic oxide] nanocomposites

AU Robertson, M. A. F.; Mauritz, K. A.

CS Department Polymer Science, University Southern Mississippi, Hattiesburg, MS, 39406-0076, USA

SO Polymer Preprints (American Chemical Society, Division of Polymer Chemistry) (1996), 37(1), 668-9

CODEN: ACPPAY; ISSN: 0032-3934

PB American Chemical Society, Division of Polymer Chemistry

DT Journal

LA English

CC 37-5 (Plastics Manufacture and Processing)

AB The structures of a nanocomposite of Nafion 1100EW sulfonate-carboxylate membranes with tetraethoxysilane are determined

ST perfluorosulfonate ionomer nanocomposite tetraethoxysilane

IT Ionomers

RL: PRP (Properties)  
(fluoropolymers, IR investigation of the silicon oxide phase in perfluorinated ionomer/inorg. oxide nanocomposites)

IT Fluoropolymers

RL: PRP (Properties)  
(ionomers, IR investigation of the silicon oxide phase in perfluorinated ionomer/inorg. oxide nanocomposites)

IT 78-10-4D, Tetraethoxysilane, reaction products with Nafion EW1100 63496-24-2D, Nafion EW1100, reaction products with tetraethoxysilane  
RL: PRP (Properties)  
(IR investigation of the silicon oxide phase in perfluorinated ionomer/inorg. oxide nanocomposites)

L57 ANSWER 54 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN  
AN 1996:244782 HCAPLUS  
DN 124:319025  
ED Entered STN: 25 Apr 1996  
TI Base-catalyzed sol-gel reactions of tetraethoxysilane in the nanostructured morphology of perfluorosulfonate ionomers  
AU Payne, J. T.; Mauritz, K. A.  
CS Department Polymer Science, University Southern Mississippi, Hattiesburg, MS, 39406-0076, USA  
SO Polymer Preprints (American Chemical Society, Division of Polymer Chemistry) (1996), 37(1), 520-1  
CODEN: ACPPAY; ISSN: 0032-3934  
PB American Chemical Society, Division of Polymer Chemistry  
DT Journal  
LA English  
CC 38-3 (Plastics Fabrication and Uses)  
AB Perfluorosulfonate ionomer (PFSI) membrane (Nafion 1100) pre-swollen with EtOH/H<sub>2</sub>O + NaOH solution was sol-gel polymerized with tetra-Et orthosilicate (TEOS) for 3 days. Solution Ph dramatically affects SiO<sub>2</sub> uptake with maximum uptake occurring in a range between pH 7.4 to 8.5. In order to avoid ion exchange within the PFSI during the sol-gel reaction of TEOS, a base was chosen whose counterion matched that of the fixed-SO<sub>3</sub><sup>-</sup> anion. Counterion matching might lessen discoloration or complex formation which could modify the in situ sol-gel reaction. SiO<sub>2</sub> uptake within the PFSI matrix increases with time of reaction.  
ST perfluorosulfonate ionomer membrane sol gel polymn; tetraethyl orthosilicate fluoropolymer sol gel polymn  
IT Membranes  
(base-catalyzed sol-gel reactions of tetraethoxysilane in nanostructured morphol. of perfluorosulfonate ionomers)  
IT Fluoropolymers  
Ionomers  
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
(base-catalyzed sol-gel reactions of tetraethoxysilane in nanostructured morphol. of perfluorosulfonate ionomers)  
IT Polymerization  
Polymerization catalysts  
(sol-gel, base-catalyzed sol-gel reactions of tetraethoxysilane in nanostructured morphol. of perfluorosulfonate ionomers)  
IT 12627-13-3, Silicate

- RL: MOA (Modifier or additive use); PRP (Properties); USES (Uses)  
 (base-catalyzed sol-gel reactions of tetraethoxysilane in  
 nanostructured morphol. of perfluorosulfonate ionomers)
- IT 93615-63-5, Nafion 1100  
 RL: POF (Polymer in formulation); PRP (Properties); USES (Uses)  
 (base-catalyzed sol-gel reactions of tetraethoxysilane in  
 nanostructured morphol. of perfluorosulfonate ionomers)
- IT 1310-73-2P, Sodium hydroxide, properties  
 RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
 (base-catalyzed sol-gel reactions of tetraethoxysilane in  
 nanostructured morphol. of perfluorosulfonate ionomers)
- IT 78-10-4, Tetraethyl orthosilicate  
 RL: RCT (Reactant); RACT (Reactant or reagent)  
 (base-catalyzed sol-gel reactions of tetraethoxysilane in  
 nanostructured morphol. of perfluorosulfonate ionomers)
- L57 ANSWER 55 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
 AN 1996:224206 HCPLUS  
 DN 124:262484  
 ED Entered STN: 17 Apr 1996  
 TI Perfluorosulfonate ionomer/Ormosil nanocomposites for transport  
 permselectivity studies  
 AU Young, S. K.; Deng, Q.; Mauritz, K. A.  
 CS Department Polymer Science, University Southern Mississippi, Hattiesburg,  
 MS, 39406-0076, USA  
 SO Polymeric Materials Science and Engineering (1996), 74, 309-10  
 CODEN: PMSEDG; ISSN: 0743-0515  
 PB American Chemical Society  
 DT Journal  
 LA English  
 CC 37-6 (Plastics Manufacture and Processing)  
 Section cross-reference(s): 38, 57  
 AB Organically modified silicates [Ormosil] containing nanocomposites were  
 obtained via in situ sol gel reactions of tetraethoxysilane with  
 diethoxydimethylsilane and tetraethoxysilane and triethoxyvinylsilane  
 within the polar clusters of perfluorosulfonic acid films [Nafion  
 ]. The Ormosil materials are inorg.-organic copolymers prepared from Si(OR)4  
 and organoalkoxysilane monomers. Through experimentation with drying  
 control chemical additives, such as THF, uptake consistency was improved.  
 Light microscopy was utilized to ensure polymer formation had taken place  
 inside the acid clusters, as opposed to on the surface. FTIR-ATR  
 spectroscopy has established structural incorporation of the di- and tri-  
 functional silanes into a copolymer network.  
 ST perfluorosulfonate ionomer membrane Ormosil nanocomposite;  
 ethoxysilane vinylsilane Nafion copolymer network  
 IT Silanes  
 RL: PEP (Physical, engineering or chemical process); PROC (Process)  
 (perfluorosulfonate ionomer membrane/Ormosil  
 nanocomposites obtained via sol-gel process for permselectivity)  
 IT Siloxanes and Silicones, preparation  
 RL: PEP (Physical, engineering or chemical process); PNU (Preparation,  
 unclassified); PREP (Preparation); PROC (Process)  
 (perfluorosulfonate ionomer membrane/Ormosil  
 nanocomposites obtained via sol-gel process for permselectivity)  
 IT Polyoxyalkylenes, processes  
 RL: PEP (Physical, engineering or chemical process); PROC (Process)  
 (fluorine- and sulfo-containing, ionomers, perfluorosulfonate ionomer  
 membrane/Ormosil nanocomposites obtained via sol-gel process  
 for permselectivity)  
 IT Membranes

(permselective, perfluorosulfonate ionomer membrane/Ormosil nanocomposites obtained via sol-gel process for permselectivity)

IT Fluoropolymers  
 RL: PEP (Physical, engineering or chemical process); PROC (Process)  
 (polyoxyalkylene-, sulfo-containing, ionomers, perfluorosulfonate ionomer membrane/Ormosil nanocomposites obtained via sol-gel process for permselectivity)

IT Ionomers  
 RL: PEP (Physical, engineering or chemical process); PROC (Process)  
 (polyoxyalkylenes, fluorine- and sulfo-containing, perfluorosulfonate ionomer membrane/Ormosil nanocomposites obtained via sol-gel process for permselectivity)

IT 78-08-0, Triethoxyvinylsilane 78-10-4,  
 Tetraethoxysilane 78-62-6, Diethoxydimethylsilane  
 RL: PEP (Physical, engineering or chemical process); PROC (Process)  
 (Ormosil precursor; perfluorosulfonate ionomer membrane/Ormosil nanocomposites obtained via sol-gel process for permselectivity)

IT 7631-86-9, Silica, processes  
 RL: PEP (Physical, engineering or chemical process); PROC (Process)  
 (Ormosil; perfluorosulfonate ionomer membrane/Ormosil nanocomposites obtained via sol-gel process for permselectivity)

IT 109-99-9, THF, uses  
 RL: NUU (Other use, unclassified); USES (Uses)  
 (drying control agent; perfluorosulfonate ionomer membrane/Ormosil nanocomposites obtained via sol-gel process for permselectivity)

IT 88029-68-9P, Diethoxydimethylsilane-tetraethoxysilane copolymer 88122-08-1P, Tetraethoxysilane-triethoxyvinylsilane copolymer  
 RL: PEP (Physical, engineering or chemical process); PNU (Preparation, unclassified); PREP (Preparation); PROC (Process)  
 (perfluorosulfonate ionomer membrane/Ormosil nanocomposites obtained via sol-gel process for permselectivity)

L57 ANSWER 56 OF 57 HCPLUS COPYRIGHT 2006 ACS on STN  
 AN 1996:221795 HCPLUS  
 ED Entered STN: 16 Apr 1996  
 TI Base-catalyzed sol-gel reactions of tetraethoxysilane in the nanostructured morphology of perfluorosulfonate ionomers.  
 AU Payne, J. T.; Mauritz, K. A.  
 CS Department Polymer Science, University Southern Mississippi, Hattiesburg, MS, 39406-0076, USA  
 SO Book of Abstracts, 211th ACS National Meeting, New Orleans, LA, March 24-28 (1996), POLY-060 Publisher: American Chemical Society, Washington, D. C.  
 CODEN: 62PIAJ  
 DT Conference; Meeting Abstract  
 LA English  
 AB Perfluorosulfonate ionomer Silicon oxide hybrid membranes were produced via in situ diffusion-controlled, base-catalyzed sol-gel reactions of tetraethoxysilane (TEOS) in prehydrated and ethanolswollen Co<sup>++</sup> form Nafion films. Percent weight uptake as a function of pH was investigated for two base catalysts: NaOH and Co(OH)<sub>2</sub>. It was found that as pH increased, percent weight uptake decreased. Maximum weight uptake in both base-catalyzed systems occurred in the pH range 7.4 - 8.5. Prehydration and swelling as a function of base type were also investigated. Samples pre-swollen in EtOH H<sub>2</sub>O + BASE had a slightly higher (-by 2%-3%) weight uptake than those swollen in EtOH H<sub>2</sub>O.

Furthermore, it was discovered that high solution pH (.apprx. 12) discolors originally-clear PFSI membranes. Ion exchange and possible complexation between base, counter ion, and or hydrolyzed TEOS are suggested.

L57 ANSWER 57 OF 57 HCAPLUS COPYRIGHT 2006 ACS on STN  
 AN 1980:147920 HCAPLUS  
 DN 92:147920  
 ED Entered STN: 12 May 1984  
 TI Ion exchange membrane  
 IN Kihara, Kunio; Toda, Hideo; Yasukawa, Eiki; Ishibashi, Toshiaki; Tokita, Taketoshi  
 PA Mitsubishi Petrochemical Co., Ltd., Japan  
 SO Ger. Offen., 28 pp.  
 CODEN: GWXXBX  
 DT Patent  
 LA German  
 IC B01J001-04; B01D013-04  
 CC 36-6 (Plastics Manufacture and Processing)  
 Section cross-reference(s): 61

## FAN.CNT 1

|      | PATENT NO.    | KIND | DATE     | APPLICATION NO. | DATE     |
|------|---------------|------|----------|-----------------|----------|
| PI   | DE 2928043    | A1   | 19800124 | DE 1979-2928043 | 19790711 |
|      | JP 55012141   | A2   | 19800128 | JP 1978-84590   | 19780713 |
|      | US 4294933    | A    | 19811013 | US 1979-54883   | 19790705 |
|      | GB 2026933    | A    | 19800213 | GB 1979-24013   | 19790710 |
|      | GB 2026933    | B2   | 19820825 |                 |          |
|      | FR 2430958    | A1   | 19800208 | FR 1979-18003   | 19790711 |
| PRAI | JP 1978-84590 | A    | 19780713 |                 |          |

## CLASS

|  | PATENT NO.  | CLASS | PATENT FAMILY CLASSIFICATION CODES   |
|--|-------------|-------|--|
|  | DE 2928043  | IC    | B01J001-04; B01D013-04   |
|  |             | IPCI  | B01J0001-04; B01D0013-04   |
|  |             | IPCR  | C08J0005-20 [I,C*]; C08J0005-22 [I,A]  |
|  | JP 55012141 | IPCI  | C08J0005-22; C08J0005-20 [C*]; B01J0047-12; B01J0047-00 [C*]   |
|  |             | IPCR  | C08J0005-20 [I,C*]; C08J0005-22 [I,A]  |
|  | US 4294933  | IPCI  | C25B0013-00  |
|  |             | NCL   | 521/027.000; 521/028.000   |
|  | GB 2026933  | IPCI  | B01D0013-04; B29D0007-02   |
|  |             | IPCR  | C08J0005-20 [I,C*]; C08J0005-22 [I,A]  |
|  | FR 2430958  | IPCI  | C08J0005-22; C08J0005-20 [C*]; C02F0001-42; C08F0230-08; C08F0230-00 [C*]; C08F0255-02; C08F0255-00 [C*] |
|  |             | IPCR  | C08J0005-20 [I,C*]; C08J0005-22 [I,A]  |

AB Ion exchange membranes are prepared by incorporating a powdered ion exchange resin into a silane-modified polyolefin, extruding the mixture into membrane form, and treating the membrane with hot water. The membranes are especially useful for desalination involving both mono- and divalent salts. Thus, a mixture of powdered sulfonated divinylbenzene-styrene copolymer 60, 100:2 graft ethylene-trimethoxyvinylsilane copolymer (I) [35312-82-4] 10, high d. polyethylene [19002-88-4] 30, and polyethylene wax 3 parts was kneaded 30 min at 180°, extruded, and formed into a film. After soaking 100 min at 95° in water, the sp. resistance of the membrane was 230 Ω-cm and 490 Ω-cm for NaCl and CaCl<sub>2</sub>, resp., compared to 270 and 670, resp., for a membrane prepared without I.

ST desalination membrane ion exchanger; vinylsilane graft

polyethylene  
IT Water purification  
(membranes for, ion exchangers in silane-modified olefin polymers as)  
IT Epoxy resins, compounds  
RL: USES (Uses)  
(reaction products with imidazole and epichlorohydrin, anion exchangers, silane-modified olefin polymer membranes containing, for desalination of water)  
IT 106-89-8D, reaction products with imidazol and epoxy resins 288-32-4D, reaction products with epichlorohydrin and epoxy resins 25068-38-6D, reaction products with imidazole 63939-13-9D, reaction products with epichlorohydrin and imidazole  
RL: USES (Uses)  
(anion exchangers, silane-modified olefin polymer membranes containing, for desalination of water)  
IT 9003-70-7D, sulfonated  
RL: USES (Uses)  
(cation exchangers, silane-modified olefin polymer membranes containing, for desalination of water)  
IT 35312-82-4  
RL: USES (Uses)  
(graft, membranes, containing ion exchange resins, for desalination of water)  
IT 9002-88-4 63411-54-1  
RL: USES (Uses)  
(membranes, containing ion exchange resins, for desalination of water)  
IT 2768-02-7  
RL: USES (Uses)  
(olefin polymer compns. containing ion exchangers and, for desalination of water)

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L1 1 SEA FILE=HCAPLUS ABB=ON US2003-627705/AP  
 L2 3 SEA FILE=REGISTRY ABB=ON (2373-23-1/BI OR 4420-74-0/BI OR  
     77950-55-1/BI OR 2373-23-1/BI OR 4420-74-0/BI OR 77950-55-1/BI)  
 L3 2 SEA FILE=REGISTRY ABB=ON L2 NOT NAF?  
 L4 1 SEA FILE=REGISTRY ABB=ON L2 AND NAF?  
 L5 STR

Si<sup>1</sup> Ak<sup>2</sup> G1<sup>3</sup>  
 1 2 3

S~S  
 @4 5

VAR G1=SO3H/SH/4

NODE ATTRIBUTES:

DEFAULT MLEVEL IS ATOM  
 DEFAULT ECLEVEL IS LIMITED

GRAPH ATTRIBUTES:

RING(S) ARE ISOLATED OR EMBEDDED  
 NUMBER OF NODES IS 5

STEREO ATTRIBUTES: NONE

L7 2828 SEA FILE=REGISTRY SSS FUL L5  
 L8 662 SEA FILE=HCAPLUS ABB=ON L3/D  
 L9 396 SEA FILE=HCAPLUS ABB=ON L4  
 L10 20550 SEA FILE=HCAPLUS ABB=ON L9 OR CATION? (2A) EXCHANG? (4A) (RESIN?  
     OR POLYMER?)  
 L11 6 SEA FILE=HCAPLUS ABB=ON L8 AND L10  
 L12 6558 SEA FILE=HCAPLUS ABB=ON L7  
 L13 9 SEA FILE=HCAPLUS ABB=ON L12 AND L10  
 L14 9 SEA FILE=HCAPLUS ABB=ON L11 OR L13  
 L15 3 SEA FILE=HCAPLUS ABB=ON L14 AND (MEMBRAN? OR FUEL (2A) CELL#)  
 L16 5360 SEA FILE=HCAPLUS ABB=ON (?SILANE? OR ?SILOXAN?) (5A) (?SULFONAT?  
     OR ?SULFID? OR ?MERCAPT?)  
 L17 29 SEA FILE=HCAPLUS ABB=ON L10 AND L16  
 L18 2 SEA FILE=HCAPLUS ABB=ON L17 AND (MEMBRAN? OR FUEL (2A) CELL#)  
 L19 35 SEA FILE=HCAPLUS ABB=ON L16 AND NAFION  
 L20 21 SEA FILE=HCAPLUS ABB=ON L19 AND (MEMBRAN? OR FUEL (2A) CELL#)  
 L21 5 SEA FILE=HCAPLUS ABB=ON L8 AND NAFION  
 L22 24 SEA FILE=HCAPLUS ABB=ON L12 AND NAFION  
 L23 15 SEA FILE=HCAPLUS ABB=ON (L21 OR L22) AND (MEMBRAN? OR  
     FUEL (2A) CELL#)  
 L24 32 SEA FILE=HCAPLUS ABB=ON L15 OR L18 OR L20 OR L23  
 L25 16 SEA FILE=HCAPLUS ABB=ON L24 AND ELECTROCHEM?/SC, SX  
 L26 9 SEA FILE=HCAPLUS ABB=ON L24 AND COMPOSITE  
 L27 9 SEA FILE=HCAPLUS ABB=ON L24 AND ELECTROLYT?  
 L28 18 SEA FILE=HCAPLUS ABB=ON (L25 OR L26 OR L27)  
 L29 14 SEA FILE=HCAPLUS ABB=ON L24 NOT L28  
 L37 2917 SEA FILE=WPIX ABB=ON (?SILANE? OR ?SILOXAN? OR SILICA) (5A) (?SU  
     LFON? OR ?SULFID? OR ?MERCAPT? OR SO3X)  
 L38 1683 SEA FILE=WPIX ABB=ON SILICA(3A) MODIF?  
 L45 21734 SEA FILE=HCAPLUS ABB=ON L37 OR L38  
 L46 162 SEA FILE=HCAPLUS ABB=ON L45 AND (L10 OR NAFION)

L47 34 SEA FILE=HCAPLUS ABB=ON L46 AND (COMPOSIT? (3A) ELECTROLYT? OR  
FUEL (2A) CELL#)  
 L51 48 SEA FILE=HCAPLUS ABB=ON L47 OR L29  
 L58 41 SEA FILE=HCAPLUS ABB=ON L28 OR L47  
 L59 7 SEA FILE=HCAPLUS ABB=ON (L51 OR L58) NOT L51  
 L60 1 SEA FILE=HCAPLUS ABB=ON L1 AND L58  
 L61 8 SEA FILE=HCAPLUS ABB=ON L59 OR L60

=> D L61 1-8 BIB ABS IND HITSTR

L61 ANSWER 1 OF 8 HCAPLUS COPYRIGHT 2006 ACS on STN  
 AN 2005:1074206 HCAPLUS  
 DN 143:348308  
 TI Organic-inorganic hybrid polymer **electrolytes** for electrode  
membrane assembly and **fuel cells**  
 IN Inagaki, Yoshio; Nomura, Kimiatsu  
 PA Fuji Photo Film Co., Ltd., Japan  
 SO Jpn. Kokai Tokkyo Koho, 36 pp.  
 CODEN: JKXXAF  
 DT Patent  
 LA Japanese  
 FAN.CNT 1

| PATENT NO.           | KIND | DATE     | APPLICATION NO. | DATE     |
|----------------------|------|----------|-----------------|----------|
| PI JP 2005272780     | A2   | 20051006 | JP 2004-92253   | 20040326 |
| PRAI JP 2004-92253   |      | 20040326 |                 |          |
| OS MARPAT 143:348308 |      |          |                 |          |

AB The present invention relates to compns. containing compds.  
 $R_1R_2N[((CH_2)_hNR_5)_j(CH_2)_iNR_4]kR_3$  and polymer **electrolytes**,  
 wherein R1, R2, R3, R4, R5 = H, (un)substituted alkyl or aryl (2 of R1,  
 R2, R3, R4, R5 = alkyl substituted with HO, carboxy acid (salts),  
 phosphoric acid (salts), or alkoxy carbonyl); h, i = 2 or 3; j = 0, 1, or  
 2; k = 0 or 1. Thus, ethylenediamine tetraacetic acid 0.0001,  
 3-mercaptopropyltributoxysilane 0.108, triethoxy[3-[[8-[(4'-[(3-ethyl-3-  
 oxetanyl)methoxy][1,1'-biphenyl]-4-yl]oxy]octyl]oxy]propyl]-silane 0.185,  
 and oxalic acid 0.02 g were dissolved and refluxed in 2.0 mL ethanol for 4  
 h, the resulting sol was dissolved in 0.7 mL chloroform, cast onto Upilex  
 75S, heated at 150°, cooled at 100° with cooling arte  
 10°/min, soaked in 2 mL 30% hydrogen peroxide solution for over night,  
 washed, and dried to give a semi-transparent proton conductor, showing  
 good low aging variation of terminal voltage compared to Nafion  
 when fabricated into a **fuel cell**.

IC ICM C08L101-02  
 ICS C08K005-17; C08L043-04; C08L071-02; C08L083-08; H01B001-06;  
 H01B013-00; H01M008-02

CC 38-3 (Plastics Fabrication and Uses)  
 Section cross-reference(s): 52

ST org inorg hybrid **electrolyte** electrode **membrane**  
 assembly **fuel cell**; mercaptopropyltributoxysilane  
 triethoxyethoxyloxytanylmethoxybiphenylmethoxyloxyoctyloxypropylsilane copolymer  
 ethylenediamine tetraacetic acid compn

IT Amines, uses  
 RL: MOA (Modifier or additive use); USES (Uses)  
 (air bubble inhibitor; preparation of organic-inorg. hybrid polymer  
**electrolytes** for electrode **membrane** assembly and  
**fuel cells**)

IT Fuel cells  
 Hybrid organic-inorganic materials  
 Polymer **electrolytes**

## Sol-gel processing

(preparation of organic-inorg. hybrid polymer **electrolytes** for electrode **membrane** assembly and **fuel cells**)

## IT Silsesquioxanes

RL: DEV (Device component use); IMF (Industrial manufacture); POF (Polymer in formulation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(protonated; preparation of organic-inorg. hybrid polymer **electrolytes** for electrode **membrane** assembly and **fuel cells**)

## IT Ionic conductors

(protonic; preparation of organic-inorg. hybrid polymer **electrolytes** for electrode **membrane** assembly and **fuel cells**)

## IT 60-00-4, Ethylenediamine tetraacetic acid, uses

RL: MOA (Modifier or additive use); USES (Uses)  
(air bubble inhibitor; preparation of organic-inorg. hybrid polymer **electrolytes** for electrode **membrane** assembly and **fuel cells**)

## IT 866034-46-0DP, protonated

RL: DEV (Device component use); IMF (Industrial manufacture); POF (Polymer in formulation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(organic-inorg. hybrid polymer **electrolytes** for electrode **membrane** assembly and **fuel cells**)

## IT 866034-47-1DP, protonated 866034-48-2DP, protonated

866034-49-3DP, protonated  
RL: DEV (Device component use); IMF (Industrial manufacture); POF (Polymer in formulation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(preparation of organic-inorg. hybrid polymer **electrolytes** for electrode **membrane** assembly and **fuel cells**)

## IT 866034-46-0DP, protonated

RL: DEV (Device component use); IMF (Industrial manufacture); POF (Polymer in formulation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(organic-inorg. hybrid polymer **electrolytes** for electrode **membrane** assembly and **fuel cells**)

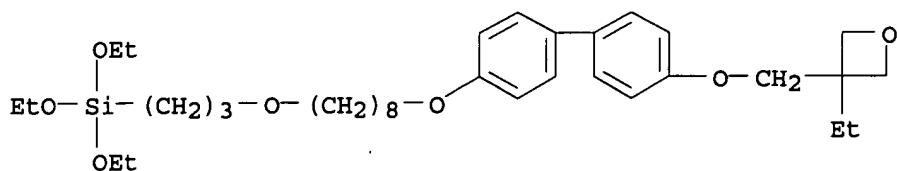
## RN 866034-46-0 HCPLUS

CN 1-Propanethiol, 3-(tributoxysilyl)-, polymer with triethoxy[3-[[8-[[4'-(3-ethyl-3-oxetanyl)methoxy] [1,1'-biphenyl]-4-yl]oxy]octyl]oxy]propyl]silane (9CI) (CA INDEX NAME)

CM 1

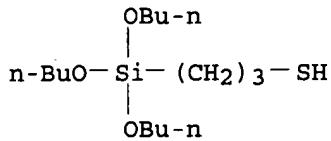
CRN 676166-84-0

CMF C35 H56 O7 Si



CM 2

CRN 42169-84-6  
 CMF C15 H34 O3 S Si



IT 866034-47-1DP, protonated 866034-48-2DP, protonated

866034-49-3DP, protonated

RL: DEV (Device component use); IMF (Industrial manufacture); POF (Polymer in formulation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)

(preparation of organic-inorg. hybrid polymer **electrolytes** for electrode **membrane** assembly and **fuel cells**)

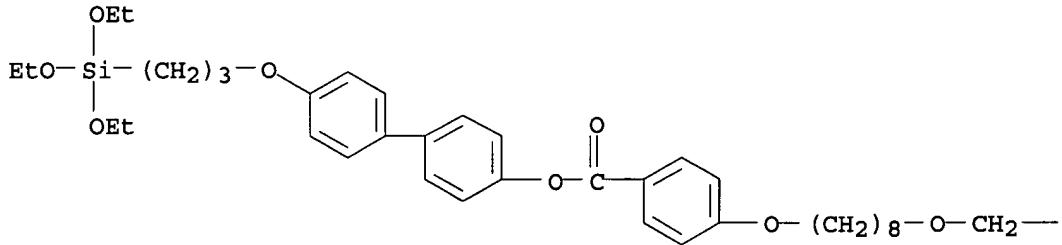
RN 866034-47-1 HCAPLUS

CN Benzoic acid, 4-[[8-[(3-ethyl-3-oxetanyl)methoxy]octyl]oxy]-, 4'-[3-(triethoxysilyl)propoxy][1,1'-biphenyl]-4-yl ester, polymer with 3-(tributoxysilyl)-1-propanethiol (9CI) (CA INDEX NAME)

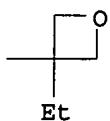
CM 1

CRN 676166-80-6  
 CMF C42 H60 O9 Si

PAGE 1-A

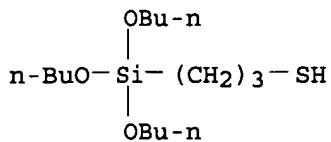


PAGE 1-B



CM 2

CRN 42169-84-6  
CMF C15 H34 O3 S Si

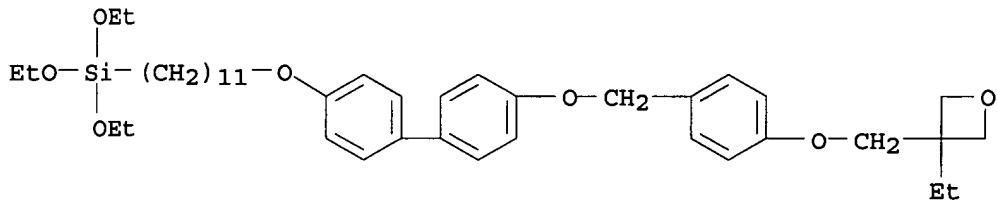


RN 866034-48-2 HCAPLUS

CN 1-Propanethiol, 3-(tributoxysilyl)-, polymer with triethoxy[11-[[4'-[[4-[(3-ethyl-3-octanyl)methoxy]phenyl]methoxy][1,1'-biphenyl]-4-yloxy]undecyl]silane (9CI) (CA INDEX NAME)

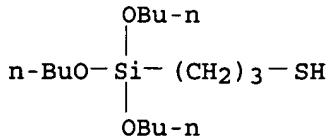
CM 1

CRN 851993-77-6  
CMF C42 H62 O7 Si



CM 2

CRN 42169-84-6  
CMF C15 H34 O3 S Si



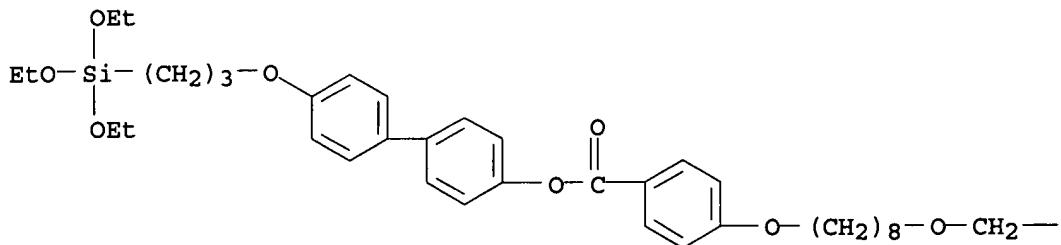
RN 866034-49-3 HCAPLUS

CN Benzoic acid, 4-[(8-[(3-ethyl-3-oxetanyl)methoxy]octyl)oxy]-, 4'-(3-(triethoxysilyl)propoxy)[1,1'-biphenyl]-4-yl ester, polymer with (tributoxysilyl)methanethiol (9CI) (CA INDEX NAME)

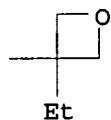
CM 1

CRN 676166-80-6  
CMF C42 H60 09 Si

PAGE 1-A

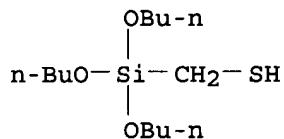


PAGE 1-B



CM 2

CRN 62896-03-1  
 CMF C13 H30 O3 S Si



L61 ANSWER 2 OF 8 HCPLUS COPYRIGHT 2006 ACS on STN  
 AN 2005:448472 HCPLUS  
 DN 144:172019  
 TI Development and characterization of polymer **electrolyte membranes** containing polysilsesquioxane spheres  
 AU Cheon, Hun Sng; Hong, Seong Uk; Kim, Young Baik; Park, Hun Hwee  
 CS Department of Chemical Engineering, Hanbat National University, Daejeon,  
 305-719, S. Korea  
 SO Membranein (2005), 15(1), 1-7  
 CODEN: MEMBEP; ISSN: 1226-0088  
 PB Membrane Society of Korea  
 DT Journal  
 LA Korean  
 AB Polymer **electrolyte membranes** containing polysilsesquioxane (PSQ) spheres were prepared with the blend of sulfonated poly(ether ether ketone) (SPEEK) (60%) and poly(ether sulfone) (PES) (40%). The amount of PSQ spheres was fixed at 10%. The prepared polymer

**electrolyte membranes** were characterized in terms of methanol permeability, proton conductivity, and ion exchange capacity. In all cases, both methanol permeability and proton conductivity of the polymer **electrolyte membranes** containing PSQ spheres were lower than the values of Nafion 117 and higher than those of SPEEK/PES (6:4) blend without PSQ spheres. The exptl. results indicated that the polymer **electrolyte membranes** containing MS64 and VTMOS spheres were the best choice in terms of the ratio of proton conductivity to methanol permeability.

- CC 38-3 (Plastics Fabrication and Uses)  
Section cross-reference(s): 36, 52
- ST development characterization polymer **electrolyte membranes** polysilsesquioxane sphere; proton cond methanol permeability
- IT Ion exchange  
Polyelectrolytes  
(development and characterization of polymer **electrolyte membranes** containing polysilsesquioxane spheres)
- IT Silsesquioxanes  
RL: MOA (Modifier or additive use); USES (Uses)  
(development and characterization of polymer **electrolyte membranes** containing polysilsesquioxane spheres)
- IT Permeability  
(methanol; development and characterization of polymer **electrolyte membranes** containing polysilsesquioxane spheres)
- IT Polysulfones, uses  
RL: PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(polyether-, blend with polyether-polyketones; development and characterization of polymer **electrolyte membranes** containing polysilsesquioxane spheres)
- IT Polyketones  
RL: PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(polyether-, sulfonated, blend with polyethersulfones; development and characterization of polymer **electrolyte membranes** containing polysilsesquioxane spheres)
- IT Polyethers, uses  
RL: PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(polyketone-, sulfonated, blend with polyethersulfones; development and characterization of polymer **electrolyte membranes** containing polysilsesquioxane spheres)
- IT Polyethers, uses  
RL: PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(polysulfone-, blend with polyether-polyketones; development and characterization of polymer **electrolyte membranes** containing polysilsesquioxane spheres)
- IT Ionic conductivity  
(proton; development and characterization of polymer **electrolyte membranes** containing polysilsesquioxane spheres)
- IT Fuel cells  
(solid **electrolyte**; development and characterization of polymer **electrolyte membranes** containing polysilsesquioxane spheres)
- IT 29295-80-5, 3-Mercaptopropyltrimethoxysilane homopolymer  
29295-80-5D, 3-Mercaptopropyltrimethoxysilane homopolymer,

oxidized 29382-69-2, Vinyltrimethoxysilane homopolymer  
 RL: MOA (Modifier or additive use); USES (Uses)  
 (assumed monomers; development and characterization of polymer  
**electrolyte membranes** containing polysilsesquioxane  
 spheres)

IT 156430-49-8 167427-18-1 167427-18-1D, oxidized  
 RL: MOA (Modifier or additive use); USES (Uses)  
 (development and characterization of polymer **electrolyte**  
**membranes** containing polysilsesquioxane spheres)

IT 29295-80-5, 3-Mercaptopropyltrimethoxysilane homopolymer  
 29295-80-5D, 3-Mercaptopropyltrimethoxysilane homopolymer,  
 oxidized  
 RL: MOA (Modifier or additive use); USES (Uses)  
 (assumed monomers; development and characterization of polymer  
**electrolyte membranes** containing polysilsesquioxane  
 spheres)

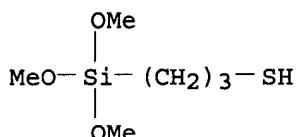
RN 29295-80-5 HCPLUS

CN 1-Propanethiol, 3-(trimethoxysilyl)-, homopolymer (9CI) (CA INDEX NAME)

CM 1

CRN 4420-74-0

CMF C6 H16 O3 S Si



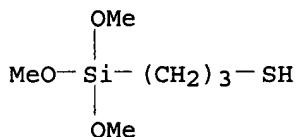
RN 29295-80-5 HCPLUS

CN 1-Propanethiol, 3-(trimethoxysilyl)-, homopolymer (9CI) (CA INDEX NAME)

CM 1

CRN 4420-74-0

CMF C6 H16 O3 S Si

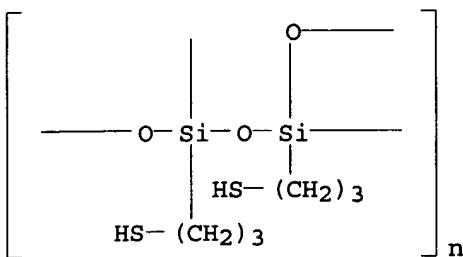


IT 167427-18-1 167427-18-1D, oxidized

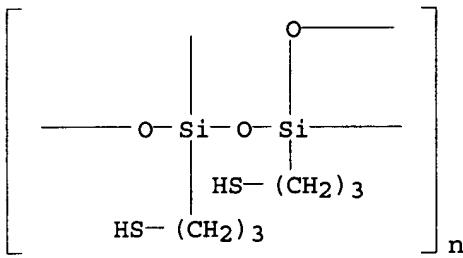
RL: MOA (Modifier or additive use); USES (Uses)  
 (development and characterization of polymer **electrolyte**  
**membranes** containing polysilsesquioxane spheres)

RN 167427-18-1 HCPLUS

CN Poly[[1,3-bis(3-mercaptopropyl)-1,3:1,3-disiloxanediylidene]-1,3-bis(oxy)] (9CI) (CA INDEX NAME)



RN 167427-18-1 HCAPLUS  
 CN Poly[[1,3-bis(3-mercaptopropyl)-1,3:1,3-disiloxanediylidene]-1,3-bis(oxy)]  
 (9CI) (CA INDEX NAME)



L61 ANSWER 3 OF 8 HCAPLUS COPYRIGHT 2006 ACS on STN  
 AN 2005:364324 HCAPLUS  
 DN 143:156188  
 TI Proton conducting organic-inorganic nanocomposite **membranes** from MPTS and GPTS  
 AU Park, Yong-il; Moon, Jooho; Kim, Hye Kyung  
 CS School of Materials and System Engineering, Kumoh National Institute of Technology, Kyungbuk, 730-701, S. Korea  
 SO Electrochemical and Solid-State Letters (2005), 8(4), A191-A194  
 CODEN: ESLEF6; ISSN: 1099-0062  
 PB Electrochemical Society  
 DT Journal  
 LA English  
 AB Novel fast proton-conducting organic-inorg. nanocomposite **membranes** were successfully fabricated. The polymer matrix obtained through proper oxidation of thiol ligands in (3-mercaptopropyl) trimethoxysilane (MPTS) and hydrolysis/condensation reaction of (3-glycidooxypropyl)trimethoxysilane (GPTS) showed relatively high proton conductivity over 10-2 S/cm at 25 °C. The proton conductivities of the fabricated **composite membranes** increased up to 3.6 + 10-1 S/cm by increasing temperature and relative humidity to 70 °C and 100% relative humidity. The high proton conductivity of the composites is due to the proton conducting path through the GPTS-derived pseudo-polyethylene oxide network in which sulfonic acid ligand work as proton donor.  
 CC 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  
 Section cross-reference(s): 35, 36, 38, 76  
 ST proton cond polyoxyalkylene siloxane sulfonic acid nanocomposite **membrane**  
 IT Polyelectrolytes

- (composite with hydrophilic PTFE membrane; proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT Humidity  
(effect on conductivity; proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT Membranes, nonbiological  
(elec. conductive; proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT Electric conductivity  
(of composite membranes; proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT Oxidation  
(of thiol group; proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT Hydrolysis  
(partial, of trimethoxy group; proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT Polysiloxanes, preparation  
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
(polyoxyalkylene-, sulfo- containing; proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT Polyoxyalkylenes, preparation  
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
(polysiloxane-, sulfo- containing; proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT Nanocomposites  
(proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT Ionic conductivity  
(proton; proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT 860308-87-8P  
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
(composite with H 020A090C PTFE membrane; proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT 860479-46-5, H 020A090C  
RL: PEP (Physical, engineering or chemical process); PYP (Physical process); TEM (Technical or engineered material use); PROC (Process); USES (Uses)  
(composite with sulfo-silylated PEO adducts; proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT 163294-14-2, Nafion 112  
RL: PRP (Properties)  
(proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT 2530-83-8, (3-Glycidoxypropyl)trimethoxysilane 4420-74-0, (3-Mercaptopropyl)trimethoxysilane  
RL: PRP (Properties); RCT (Reactant); RACT (Reactant or reagent)  
(proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT 70942-24-4P, 3-(Trihydroxysilyl)-1-propanesulfonic acid  
RL: PRP (Properties); RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)  
(proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)
- IT 7722-84-1, Hydrogen peroxide, reactions  
RL: RCT (Reactant); RACT (Reactant or reagent)

## (proton conducting organic-inorg. nanocomposite membranes from MPTS and GPTS)

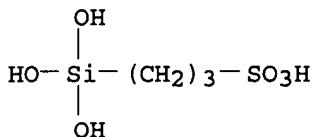
IT 860308-87-8P  
RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
(composite with H 020A090C PTFE membrane; proton  
conducting organic-inorg. nanocomposite membranes from MPTS and  
GPTS)

RN 860308-87-8 HCAPLUS  
CN 1-Propanesulfonic acid, 3-(trihydroxysilyl)-, polymer with trimethoxy[3-(oxiranylmethoxy)propyl]silane (9CI) (CA INDEX NAME)

CM 1

CRN 70942-24-4

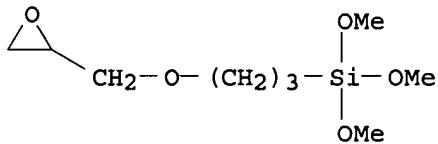
CMF C3 H10 O6 S Si



CM 2

CRN 2530-83-8

CMF C9 H2O O5 Si

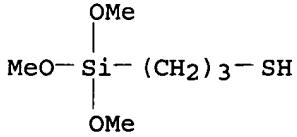


IT 4420-74-0, (3-Mercaptopropyl)trimethoxysilane

RL: PRP (Properties); RCT (Reactant); RACT (Reactant or reagent)  
(proton conducting organic-inorg. nanocomposite **membranes** from  
MPTS and GPTS)

RN 4420-74-0 HCAPLUS

CN 1-Propanethiol, 3-(trimethoxysilyl)- (7CI, 8CI, 9CI) (CA INDEX NAME)

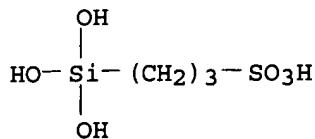


IT 70942-24-4P, 3-(Trihydroxysilyl)-1-propanesulfonic acid

RL: PRP (Properties); RCT (Reactant); SPN (Synthetic preparation); PREP (Preparation); RACT (Reactant or reagent)  
(proton conducting organic-inorg. nanocomposite membranes from  
MPTS and GPTS)

RN 70942-24-4 HCAPLUS

CN 1-Propanesulfonic acid, 3-(trihydroxysilyl)- (9CI) (CA INDEX NAME)



RE.CNT 23 THERE ARE 23 CITED REFERENCES AVAILABLE FOR THIS RECORD  
ALL CITATIONS AVAILABLE IN THE RE FORMAT

- L61 ANSWER 4 OF 8 HCAPLUS COPYRIGHT 2006 ACS on STN  
AN 2004:938511 HCAPLUS  
DN 142:94491  
TI Self-assembled organic/inorganic hybrids as **membrane** materials  
AU Mauritz, K. A.; Mountz, D. A.; Reuschle, D. A.; Blackwell, R. I.  
CS Department of Polymer Science, The University of Southern Mississippi,  
Hattiesburg, MS, 39406-0076, USA  
SO Electrochimica Acta (2004), 50(2-3), 565-569  
CODEN: ELCAAV; ISSN: 0013-4686  
PB Elsevier B.V.  
DT Journal; General Review  
LA English  
AB A review. Self-assembled organic-inorg. **membranes** prepared via  
sol-gel polymerization of silicon alkoxides and sulfonated polystyrene-[soft  
block]-polystyrene block copolymers are described. The nanoscopic  
morphol., mol. structure of hydrophilic silicate Ormosil nanophases, and  
methods of studying the structure and transport of water through these  
**membranes** are discussed. These hydrocarbon-based hybrids are  
contrasted with the earlier successful efforts to generate **Nafion**  
/silicate nanocomposite **membranes** produced in similar fashion,  
but using pre-formed films.  
CC 37-0 (Plastics Manufacture and Processing)  
Section cross-reference(s): 38, 72  
ST review hybrid **membrane** silane sulfonated  
polystyrene water transport  
IT Silanes  
RL: CPS (Chemical process); PEP (Physical, engineering or chemical  
process); PROC (Process)  
(alkoxy; structure of self-assembled silicate-sulfonated styrene block  
copolymer hybrid **membranes** and water transport)  
IT **Membranes**, nonbiological  
(hybrid; structure of self-assembled silicate-sulfonated styrene block  
copolymer hybrid **membranes** and water transport)  
IT Polymer morphology  
(phase; structure of self-assembled silicate-sulfonated styrene block  
copolymer hybrid **membranes** and water transport)  
IT Sol-gel processing  
(polymerization; structure of self-assembled silicate-sulfonated styrene  
block  
copolymer hybrid **membranes** and water transport)  
IT Polymerization  
(sol-gel; structure of self-assembled silicate-sulfonated styrene block  
copolymer hybrid **membranes** and water transport)  
IT Hybrid organic-inorganic materials  
Hydrophilicity  
Molecular structure  
Nanocomposites  
(structure of self-assembled silicate-sulfonated styrene block

copolymer hybrid **membranes** and water transport)  
IT 100-42-5D, Styrene, block copolymers, sulfonated  
RL: CPS (Chemical process); PEP (Physical, engineering or chemical  
process); PROC (Process)  
(structure of self-assembled silicate-sulfonated styrene block  
copolymer hybrid **membranes** and water transport)  
IT 7732-18-5, Water, processes  
RL: PEP (Physical, engineering or chemical process); PYP (Physical  
process); PROC (Process)  
(structure of self-assembled silicate-sulfonated styrene block  
copolymer hybrid **membranes** and water transport)  
RE.CNT 22 THERE ARE 22 CITED REFERENCES AVAILABLE FOR THIS RECORD  
ALL CITATIONS AVAILABLE IN THE RE FORMAT

L61 ANSWER 5 OF 8 HCAPLUS COPYRIGHT 2006 ACS on STN  
AN 2004:839092 HCAPLUS  
DN 142:25775  
TI Hybrid proton-carrier polymer composites for high-temperature FCPEM  
applications  
AU Pern, F. J.; Turner, J. A.; Herring, A. M.  
CS National Renewable Energy Laboratory, Golden, CO, 80401, USA  
SO Materials Research Society Symposium Proceedings (2004),  
822(Nanostructured Materials in Alternative Energy Devices), 159-164  
CODEN: MRSPDH; ISSN: 0272-9172  
PB Materials Research Society  
DT Journal  
LA English  
AB Hybrid proton-carrier polymer composites were fabricated in an effort to  
develop high-performance high-temperature proton exchange **membranes**  
(PEMs) for **fuel cell** applications in the  
100°-200 °C range. The solution-cast hybrid **membranes**  
comprise a polymer host and a SiO<sub>2</sub>-based proton-carrier composite  
that was synthesized via sol gel approach using a functional silane and  
tetraethoxysilane (TEOS) in acidic conditions. The primary H<sup>+</sup>-carrying  
component was either a heteropoly silicotungstic acid (STA) or a sulfonic  
acid (SFA) that was thermo-oxidatively converted from a mercapto (-SH)  
group. The embedding level of STA on the silane-modified SiO<sub>2</sub> sol gel  
composites was strongly affected by the presence and the functional group  
of the silane. Ion exchange capacity (IEC) of the water-washed,  
SiO<sub>2</sub>-based STA and SFA proton-carrier composite powders is at  
1.8-3.5 mmol/g, two to three times higher than that for Nafion  
117 (0.9 meq/mol). A glycidyl methacrylate-type copolymer, PEMAGMA, which  
is stable up to .apprx.225 °C, was able to produce mech. robust and  
flexible hybrid **membranes**. Upon curing, the PEMAGMA  
composite **membranes** showed a .apprx. 75% gel under the  
present formulation and retained the free STA effectively with slight loss  
when extracted in an 85 °C water. The W12-STA-containing PEMAGMA  
**membranes** followed the weight loss trends of water from STA and the  
SiO<sub>2</sub>-based sol gel composite, showing a 10% loss at 150  
°C and a 15% loss at 225 °C. **Fuel cell**  
performance tests of the preliminary films gave a Voc in the 0.85-0.93 V  
range, but a low c.d. of <4 mA/cm<sup>2</sup>. The resistive characteristics were  
attributed to inhomogeneous distribution of the sol gel nanoparticles in  
the PEMAGMA matrix, a result of phase separation and particulate agglomeration  
during film forming.  
CC 52-2 (**Electrochemical**, Radiational, and Thermal Energy  
Technology)  
Section cross-reference(s): 38, 49, 57, 72, 76  
ST hybrid proton conductive exchange **membrane** polymer  
composite **fuel cell**

- IT Silsesquioxanes  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(acrylic-epoxy-, composites with silicotungstic acids; hybrid proton-carrier polymer composites for high-temperature FCPEM applications)
- IT Epoxy resins, uses  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(acrylic-silsesquioxane-, composites with silicotungstic acids; hybrid proton-carrier polymer composites for high-temperature FCPEM applications)
- IT Silsesquioxanes  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(epoxy-, composites with silicotungstic acids; hybrid proton-carrier polymer composites for high-temperature FCPEM applications)
- IT Ceramers  
Composites  
Ion exchange  
Ion exchange **membranes**  
(hybrid proton-carrier polymer composites for high-temperature FCPEM applications)
- IT Sulfonic acids, uses  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); TEM (Technical or engineered material use); PREP (Preparation); USES (Uses)  
(in polymer **composite membranes** in **fuel cells**; hybrid proton-carrier polymer composites for high-temperature FCPEM applications)
- IT Current density  
Open circuit potential  
(of assembled **fuel cells**; hybrid proton-carrier polymer composites for high-temperature FCPEM applications)
- IT Fuel cells  
(proton exchange **membrane**; hybrid proton-carrier polymer composites for high-temperature FCPEM applications)
- IT Ionic conductivity  
(proton; hybrid proton-carrier polymer composites for high-temperature FCPEM applications)
- IT Epoxy resins, uses  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic preparation); PREP (Preparation); USES (Uses)  
(silsesquioxane-, composites with silicotungstic acids; hybrid proton-carrier polymer composites for high-temperature FCPEM applications)
- IT Heteropoly acids  
RL: DEV (Device component use); MOA (Modifier or additive use); USES (Uses)  
(tungstosilicic; hybrid proton-carrier polymer composites for high-temperature FCPEM applications)
- IT 12412-85-0  
RL: DEV (Device component use); MOA (Modifier or additive use); USES (Uses)  
(composites with functional silicas; hybrid proton-carrier polymer composites for high-temperature FCPEM applications)
- IT 12027-38-2, 12-Tungstosilicic acid  
RL: DEV (Device component use); MOA (Modifier or additive use); PRP (Properties); USES (Uses)  
(composites with functional silicas; hybrid proton-carrier polymer composites for high-temperature FCPEM applications)
- IT 175340-30-4P 799855-05-3P  
RL: DEV (Device component use); PRP (Properties); SPN (Synthetic

preparation); PREP (Preparation); USES (Uses)  
 (composites with silicotungstic acids; hybrid proton-carrier polymer  
 composites for high-temperature FCPEM applications)

IT 7631-86-9P, Silica, preparation 11099-06-2P, Poly(tetraethoxysilane)  
 141087-50-5P 141087-51-6P 654051-88-4P  
 RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
 (composites with silicotungstic acids; hybrid proton-carrier polymer  
 composites for high-temperature FCPEM applications)

IT 7647-01-0, Hydrochloric acid, uses  
 RL: MOA (Modifier or additive use); RCT (Reactant); RACT (Reactant or  
 reagent); USES (Uses)  
 (hybrid proton-carrier polymer composites for high-temperature FCPEM  
 applications)

IT 180913-36-4DP, sulfonic acid derivative reaction products with  
 hydrogen peroxide 438245-45-5DP, sulfonic acid derivative reaction  
 products with hydrogen peroxide  
 RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
 (hybrid proton-carrier polymer composites for high-temperature FCPEM  
 applications)

IT 66796-30-3, Nafion 117  
 RL: PRP (Properties); TEM (Technical or engineered material use); USES  
 (Uses)  
 (hybrid proton-carrier polymer composites for high-temperature FCPEM  
 applications)

IT 180913-36-4DP, sulfonic acid derivative reaction products with  
 hydrogen peroxide 438245-45-5DP, sulfonic acid derivative reaction  
 products with hydrogen peroxide  
 RL: PRP (Properties); SPN (Synthetic preparation); PREP (Preparation)  
 (hybrid proton-carrier polymer composites for high-temperature FCPEM  
 applications)

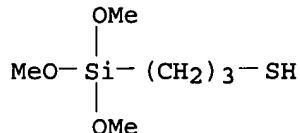
RN 180913-36-4 HCAPLUS

CN 2-Propenoic acid, 2-methyl-, 3-(trimethoxysilyl)propyl ester, polymer with  
 3-(trimethoxysilyl)-1-propanethiol (9CI) (CA INDEX NAME)

CM 1

CRN 4420-74-0

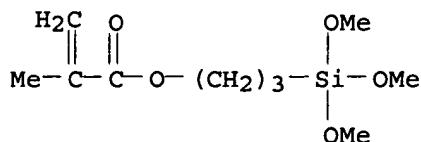
CMF C6 H16 O3 S Si



CM 2

CRN 2530-85-0

CMF C10 H20 O5 Si



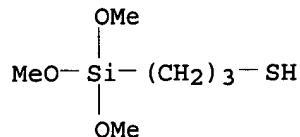
RN 438245-45-5 HCAPLUS

CN 2-Propenoic acid, 2-methyl-, 3-(trimethoxysilyl)propyl ester, polymer with silicic acid (H<sub>4</sub>SiO<sub>4</sub>) tetraethyl ester and 3-(trimethoxysilyl)-1-propanethiol (9CI) (CA INDEX NAME)

CM 1

CRN 4420-74-0

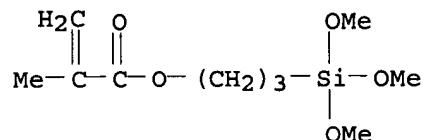
CMF C6 H16 O3 S Si



CM 2

CRN 2530-85-0

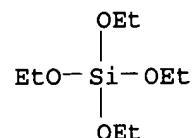
CMF C10 H20 O5 Si



CM 3

CRN 78-10-4

CMF C8 H20 O4 Si



RE.CNT 10 THERE ARE 10 CITED REFERENCES AVAILABLE FOR THIS RECORD  
ALL CITATIONS AVAILABLE IN THE RE FORMAT

L61 ANSWER 6 OF 8 HCAPLUS COPYRIGHT 2006 ACS on STN

AN 2004:701136 HCAPLUS

DN 141:228099

TI Composite electrolyte membrane and  
fuel cell which uses the membrane

IN Cho, Joo Hee; Park, Chan Ho

PA Samsung SDI Co., Ltd., S. Korea

SO Jpn. Kokai Tokkyo Koho, 12 pp.

CODEN: JKXXAF

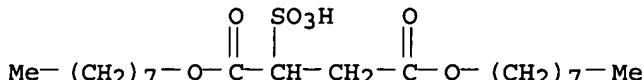
DT Patent

X

LA Japanese

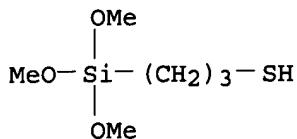
FAN.CNT 1

|      | PATENT NO.  | KIND | DATE     | APPLICATION NO. | DATE         |
|------|---|------|----------|-----------------|--------------|
| PI   | JP 2004241391   | A2   | 20040826 | JP 2004-30823   | 20040206     |
|      | CN 1519970  | A    | 20040811 | CN 2003-147567  | 20030724     |
|      | US 2005175880   | A1   | 20050811 | US 2003-627705  | 20030728 <-- |
| PRAI | KR 2003-8007  | A    | 20030208 |                 |              |
| AB   | The membrane contains a modified silica, obtained by bonding a 1st substituent: R1-SO <sub>3</sub> X (R1 = C <sub>2</sub> -7 alkylene group; and X = H or alkali metal) and a 2nd substituent: R2-S-S-R3 (R2, R3 = C <sub>2</sub> -7 alkylene group) to Si atoms, and a polymer containing a cation exchange group. The fuel cell has the above electrolyte between a cathode and an anode. |      |          |                 |              |
| IC   | ICM H01M008-02  |      |          |                 |              |
|      | ICS H01B001-06; H01M008-10  |      |          |                 |              |
| CC   | 52-2 (Electrochemical, Radiational, and Thermal Energy Technology)  |      |          |                 |              |
| ST   | fuel cell electrolyte membrane<br>modified silica polymer; electrolyte<br>membrane modified silica cation<br>exchanger group contg polymer  |      |          |                 |              |
| IT   | Fuel cell electrolytes<br>(composite electrolyte membranes having<br>modified silica and cation exchange<br>group containing polymers for fuel cells)   |      |          |                 |              |
| IT   | 2373-23-1D, Dioctyl sulfosuccinate, reaction product with Nafion 115 and 3-Pr trimethoxy mercaptosilane<br>4420-74-0D, reaction product with Nafion 115 and dioctyl sulfosuccinate<br>RL: TEM (Technical or engineered material use); USES (Uses)<br>(composite electrolyte membranes having<br>modified silica and cation exchange<br>group containing polymers for fuel cells)            |      |          |                 |              |
| IT   | 77950-55-1, Nafion 115<br>RL: TEM (Technical or engineered material use); USES (Uses)<br>(reaction product with 3-Pr trimethoxy mercaptosilane and dioctyl sulfosuccinate; composite electrolyte<br>membranes having modified silica and<br>cation exchange group containing polymers for<br>fuel cells)  |      |          |                 |              |
| IT   | 2373-23-1D, Dioctyl sulfosuccinate, reaction product with Nafion 115 and 3-Pr trimethoxy mercaptosilane<br>4420-74-0D, reaction product with Nafion 115 and dioctyl sulfosuccinate<br>RL: TEM (Technical or engineered material use); USES (Uses)<br>(composite electrolyte membranes having<br>modified silica and cation exchange<br>group containing polymers for fuel cells)            |      |          |                 |              |
| RN   | 2373-23-1 HCPLUS  |      |          |                 |              |
| CN   | Butanedioic acid, sulfo-, 1,4-dioctyl ester (9CI) (CA INDEX NAME)   |      |          |                 |              |



RN 4420-74-0 HCPLUS

CN 1-Propanethiol, 3-(trimethoxysilyl)- (7CI, 8CI, 9CI) (CA INDEX NAME)



IT 77950-55-1, Nafion 115

RL: TEM (Technical or engineered material use); USES (Uses)  
 (reaction product with 3-Pr trimethoxy mercaptosilane and dioctyl  
 sulfosuccinate; composite electrolyte  
 membranes having modified silica and  
 cation exchange group containing polymers for  
 fuel cells)

RN 77950-55-1 HCAPLUS

CN Nafion 115 (9CI) (CA INDEX NAME)

\*\*\* STRUCTURE DIAGRAM IS NOT AVAILABLE \*\*\*

L61 ANSWER 7 OF 8 HCAPLUS COPYRIGHT 2006 ACS on STN

AN 2004:317690 HCAPLUS

DN 141:108757

TI Gas diffusion electrodes for polymer electrolyte fuel  
cells using novel organic/inorganic hybrid electrolytesAU Nishikawa, Osamu; Doyama, Kazuo; Miyatake, Kenji; Uchida, Hiroyuki;  
Watanabe, MasahiroCS NBO Development Center, Sekisui Chemical Co., Ltd., Tsukuba, 300-4292,  
JapanSO Electrochemistry (Tokyo, Japan) (2004), 72(4), 232-237  
CODEN: EECTFA; ISSN: 1344-3542

PB Electrochemical Society of Japan

DT Journal

LA English

AB Gas diffusion electrodes were prepared for polymer electrolyte  
fuel cells (PEFC) using new organic/inorg. hybrid  
electrolytes. The catalyst layers were prepared by mixing  
3-(trihydroxy-silyl)-1-propane-sulfonic acid [C(THS)Pro-SO<sub>3</sub>H],  
1,8-bis(triethoxysilyl) octane (TES-Oct), Pt loaded C black (Pt-CB) and  
H<sub>2</sub>O, followed by sol-gel reaction. The polarization properties and the  
microstructure of the catalyst layer were studied as a function of the  
composition. The catalyst layer exhibited higher catalyst use than of  
conventional Nafion ionomer. The maximum cathode performance was  
obtained at (THS)Pro-SO<sub>3</sub>H/CB = 1 (by weight). Hg porosimetry showed that the  
volume of primary and secondary pores decreased with increasing content of  
acidic ionomer. The improved catalyst use with increasing acid content is  
ascribed to enhanced p conduction because the hybrid ionomer could  
penetrate the primary and secondary pores. However, an excess ionomer  
loading showed a detrimental effect due to disturbance of the gas  
diffusion. The novel organic/inorg. hybrid materials are potential ionomers  
in the electrodes of high-temperature PEFCs.

CC 52-2 (Electrochemical, Radiational, and Thermal Energy  
Technology)

Section cross-reference(s): 38

ST org inorg hybrid electrolyte gas diffusion electrode  
fuel cell

IT Carbon black, uses

RL: CAT (Catalyst use); DEV (Device component use); USES (Uses)  
 (Pt-loaded; gas diffusion electrodes for polymer electrolyte

fuel cells using organic/inorg. hybrid electrolytes)

IT Fuel cell cathodes

- Fuel cell electrodes
- Fuel cell electrolytes

Hybrid organic-inorganic materials

- (gas diffusion electrodes for polymer electrolyte fuel cells using organic/inorg. hybrid electrolytes)

IT Electrodes

- (gas-diffusion; gas diffusion electrodes for polymer electrolyte fuel cells using organic/inorg. hybrid electrolytes)

IT Fuel cells

- (polymer electrolyte; gas diffusion electrodes for polymer electrolyte fuel cells using organic/inorg. hybrid electrolytes)

IT 7440-06-4, Platinum, uses

RL: CAT (Catalyst use); DEV (Device component use); USES (Uses)

- (gas diffusion electrodes for polymer electrolyte fuel cells using organic/inorg. hybrid electrolytes)

IT 52217-60-4D, 1,8-Bis(triethoxysilyl) octane, reaction products with hydroxy-silyl propanesulfonic acid 70942-24-4D, 3-(Trihydroxy-silyl)-1-propane-sulfonic acid, reaction products with ethoxy-silyl octane

RL: DEV (Device component use); USES (Uses)

- (gas diffusion electrodes for polymer electrolyte fuel cells using organic/inorg. hybrid electrolytes)

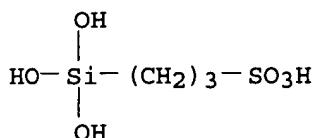
IT 70942-24-4D, 3-(Trihydroxy-silyl)-1-propane-sulfonic acid, reaction products with ethoxy-silyl octane

RL: DEV (Device component use); USES (Uses)

- (gas diffusion electrodes for polymer electrolyte fuel cells using organic/inorg. hybrid electrolytes)

RN 70942-24-4 HCPLUS

CN 1-Propanesulfonic acid, 3-(trihydroxysilyl)- (9CI) (CA INDEX NAME)



RE.CNT 17 THERE ARE 17 CITED REFERENCES AVAILABLE FOR THIS RECORD  
ALL CITATIONS AVAILABLE IN THE RE FORMAT

L61 ANSWER 8 OF 8 HCPLUS COPYRIGHT 2006 ACS on STN  
 AN 1996:572749 HCPLUS  
 DN 125:248577  
 TI Asymmetric [Nafion]/[silicon oxide] [ hybrid membranes via the in situ sol-gel reaction for tetraethoxysilane  
 AU Gummaraju, Raghuram V.; Moore, R. B.; Mauritz, K. A.  
 CS Dep. Polymer Sci., Univ. Southern Mississippi, Hattiesburg, MS, 39406-0076, USA  
 SO Journal of Polymer Science, Part B: Polymer Physics (1996), 34(14), 2383-2392

CODEN: JPBPEM; ISSN: 0887-6266

PB Wiley  
DT Journal  
LA English  
AB Asym. silicon oxide composition profiles along a direction perpendicular to the plane of **Nafion** sulfonate films were created via in-situ sol-gel reactions for one-sided tetraethoxysilane permeation, as verified by EDAX/ESEM. For K+-form **membranes**, we propose the existence of an IR-spectra signature of mol. branches in addition to those characteristic of linear and cyclic fragments in the silicon-oxide phase. The mol. structure of the silicon-oxide phase is more interconnected than linear in K+-form **membranes**. For H+-form **membranes**, there appears to be an increasing degree of mol. linearity within the silicon-oxide phase with increasing uptake. IR spectra indicate that mol. connectivity on the permeated side is lower, on the average, than that on the nonpermeated side. The inverse relationship between gas permeability and upstream pressure in steady-state helium-gas transmission expts. suggests dual-mode sorption of gases, which is in harmony with the multiphasic nature of these **membranes**.  
CC 35-3 (Chemistry of Synthetic High Polymers)  
Section cross-reference(s): 36, 38  
ST tetraethoxysilane polymer **Nafion composite membrane; perfluorosulfonate ionomer siloxane composite membrane**  
IT **Membranes**  
    Permeability and Permeation  
        (asym. **Nafion**/silicon oxide hybrid **membranes** via the in situ sol-gel reaction for tetraethoxysilane)  
IT Siloxanes and Silicones, properties  
RL: PRP (Properties)  
    (asym. **Nafion**/silicon oxide hybrid **membranes** via the in situ sol-gel reaction for tetraethoxysilane)  
IT Polyoxyalkylenes, properties  
RL: PRP (Properties)  
    (fluorine- and sulfo-containing, ionomers, asym. **Nafion**/silicon oxide hybrid **membranes** via the in situ sol-gel reaction for tetraethoxysilane)  
IT Fluoropolymers  
RL: PRP (Properties)  
    (polyoxyalkylene-, sulfo-containing, ionomers, asym. **Nafion**/silicon oxide hybrid **membranes** via the in situ sol-gel reaction for tetraethoxysilane)  
IT Ionomers  
RL: PRP (Properties)  
    (polyoxyalkylenes, fluorine- and sulfo-containing, asym. **Nafion**/silicon oxide hybrid **membranes** via the in situ sol-gel reaction for tetraethoxysilane)  
IT 11099-06-2, Tetraethoxysilane homopolymer  
RL: PRP (Properties)  
    (asym. **Nafion**/silicon oxide hybrid **membranes** via the in situ sol-gel reaction for tetraethoxysilane)  
IT 7440-59-7, Helium, miscellaneous  
RL: MSC (Miscellaneous)  
    (permeation of helium through asym. **Nafion**/silicon oxide hybrid **membranes**)

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